JUL 19 1924

Engineering News-Record

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July 17, 1924

Alum Agitation Studies
at Reading, Pa.
By CHARLES R. COX

Improving the Cleveland-Pittsburgh Line
of the Pennsylvania R.R.

Some Requirements in the Study of Portland Cement
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in Northern Quebec
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Reviews of Latest Books on Engineering Subjects

Revision on Pennsylvania Railroad
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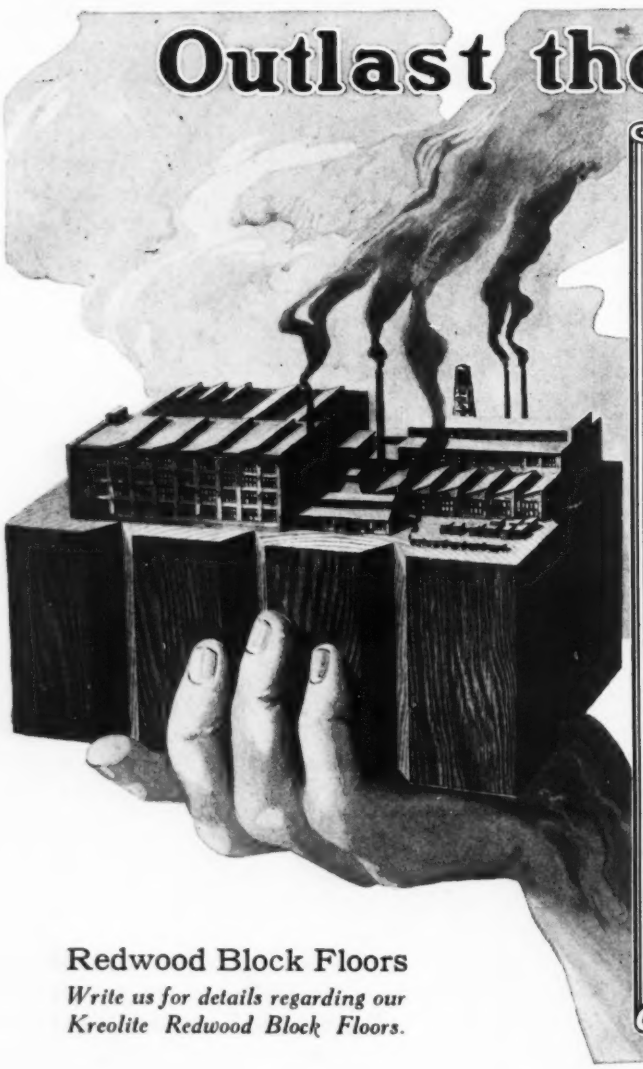

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 93 NEW YORK, JULY 17, 1924 Number 3

For World Stability

SO ABSORBED have we been in this country in the past month in the complicated business of choosing candidates for the presidency that most of us have failed to note the importance of the meeting which began in London yesterday. Out of these conferences will come some arrangement by which Europe may begin to move toward financial and political stability. Failing agreement now on a policy—which means failing to accept the Dawes plan in principle—Europe will continue to mark time or to go backward until the general situation gets a little worse than it is even now. Every European government that has fought compromise has now disappeared and liberal minded governments have taken their place. The hope of world stability and a start toward progress rests on the ability of these new governments to get together.

Time to Make Amend

NOW that the new attorney-general has had time to orient himself he should consider seriously the necessity for a public apology for the pernicious activity of his predecessor in the prosecution of some of the so-called "war frauds" cases. Our Washington correspondent this week reports the second vindication by federal judges of E. C. Morse, the Director of Sales who seems to have been one of the greatest victims of the persecution by special assistant attornies general. Mr. Morse's counsel now calls on the department for a general cleaning up of these cases and a confession of what at best is misdirected activity and at worst vicious persecution for political profit. Many of these cases are outside the purview of a technical journal but those that were brought against engineers and contractors engaged in work which *Engineering News-Record* did have knowledge of bore every mark of the kind of evil intent which Mr. Morse's counsel now charges. The Coolidge administration has a chance to make manly amend for the malpractice of its predecessor.

Trouble on the Alaska R.R.

FOR some time stories have been coming out of Alaska telling of the utter demoralization of the government railway forces due to the activities of the new general manager, Lee H. Landis, appointed last summer by Secretary of the Interior Work. Alaska is so far away and the conditions there so peculiar that it would be most unsafe to repeat any of these stories or to draw conclusions therefrom. So many of the white inhabitants of the territory are government employees that any new officer coming there would be bound to produce what might amount to a class revolt if he attempted to reduce or replace the resident forces, which is apparently what Colonel Landis has been doing. But nevertheless evidence is growing that the new general manager is far from the proper person for the job, and not the least of this evidence is the fact, reported in our news columns, that Secretary Work has dispatched a real railroad man to Alaska on what appears to be a clean-up mission. Until Mr. Smith reports, comment as to the situation can well be withheld. But it is obvious that running a railroad in a remote territory is another of the several things that a government finds difficult.

The Channel Tunnel Vetoed

SECURE in our remoteness and size, and bordered only with friendly neighbors, we of the United States cannot understand the reluctance of the English to build the channel tunnel. For a century this obvious transportation artery has been advocated and each time it is considered seriously enough to reach official circles, the military advisors to the British government veto it. Such a veto has once more been exercised. On July 7 Prime Minister MacDonald announced in the House of Commons that the government had decided against the tunnel, and the pretty well authenticated rumor is that the high military authorities are responsible. In these days of big guns and air warfare, which open the British Isles to ready attack, and with the very simple defense against invasion through the tunnel afforded by gas and flooding, it is hard to understand the military opposition to the tunnel, but history and tradition are potent forces in the desire to preserve, theoretically at least, the splendid isolation that has for so many centuries been England's safeguard.

Typhoid Recrudescence

SEVERAL outbreaks of water-borne typhoid within the past year and the recent sharp rise in weekly case reports for New York City point to the need for more alertness on the part of water and health officials. Early this year the Washington State Board of Health adopted the stringent rules against cross-connection noted in these columns last week. The California State Board of Health has just got out a special bulletin on "Water Supplies: Rules and Regulations." As a foreword the bulletin summarizes two recent California water-borne outbreaks. One of these, "the largest in the history of the state," occurred early this year, caused over 600 cases and 50 deaths within a population of some 50,000 (Santa Ana and vicinity) and was due to the infection of a well from an unknown sewer. The other was the South Pasadena case, in which leakage from a cracked sewer entered a corroded and leaky steel water pipe. (See *Engineering News-Record*, March 6, p. 409, and June 12, p. 1105.) These two epidemics, the cross-connection outbreak at Everett, Wash., last year and the coincidence of a reversal of the flow of the Chicago River into Lake Michigan and supposedly temporary deficiency in chlorination of a part of the Chicago water supply late in 1923, strike with lightning-like swiftness and unexpectedness both as time and place. Less dramatic but serious enough are the sud-

den rises in typhoid case curves in supposedly well guarded cities like New York. Although a recrudescence of typhoid for the whole country is not to be expected, these random epidemics and sharp rises in weekly case rates have been so frequent of late as to demand the prompt and careful attention of all who are responsible for the purity of water supplies and the health of the people.

Transport Survey Progress

HIGHWAY transport surveys have gone a long way ahead of the traffic census. So rapid has the advance been that the Connecticut survey which has barely been concluded is almost elementary compared with the Pennsylvania survey only recently begun and outlined elsewhere in this issue, or with that of Cook County noted in our issue of July 3. In these most recent studies the count of vehicles traveling the present roads is merely incidental to the task of amassing a variety of complex economic information. The purposes of the survey are clearly enough indicated in the current article to require no retelling. It is the breadth and detail of the facts being searched for that merit consideration. There are few examples of economic studies involving a wider range of factors. A notable feature is that it is sought to learn not merely when an improved road is warranted and how extensive the improvement should be but it is also sought to discover when exceptional construction, as grade crossing elimination, is economically justified. In all respects there is enormous potential wealth of highway engineering and road traffic facts in the Pennsylvania transport survey. Their analysis and presentation to highway officials should be prompt.

Reviving Cement Study

THE comments of Mr. Merriman, on another page of this issue, as to some of the requirements in the study of cement voice in more specific form and probably with a wider background of study the thoughts of many users of concrete. A year or so ago such thoughts branded one as a heretic. By common consent or by lack of interest it was generally accepted that portland cement had finally been brought to within the human range of perfection and that to make better concrete, an obvious necessity, improvement in the other ingredients and in methods of production were required. The drive toward these latter improvements was started and it has met with unhoped for success. Those who care to follow the principles and practices set up by the later students of the concrete art can make measurably better concrete today than they could ten years ago. Indeed, so far ahead has the study of aggregate, water and methods progressed that many engineers, like Mr. Merriman, are turning once more to the study of the cement. For a time the cement experts appeared to be not too friendly to this attitude. Even the accepted authority on cement standards, Committee C-1 of the American Society for Testing Materials, marked time not only in action, which was perhaps pardonable, but also in research. But the tide has turned. The cement manufacturers and the Bureau of Standards are starting a most elaborate investigation, with a program approximating that suggested by Mr. Merriman. Committee C-1, in its report last month, goes out of its way to emphasize its very real interest in the make-up and behavior of cement and to outline the activities of the committee in studying these subjects. Portland cements, and some of their cousins, are coming in for a revival of investigation, a revival that cannot but benefit concrete, and incidentally, we believe, the makers of cement themselves.

Time to Try the Case

COLORADO River flood control and power projects are again in the limelight as the result of the vigorous discussion at the recent Pasadena convention of the American Society of Civil Engineers. Perhaps it is unavoidable, but it seems unfortunate that leading engineers familiar with Colorado River conditions —and they are the ones to whom the country must look for advice in this matter—had to debate their differences at a public meeting which has all the attractions for careless publicity that surround an annual convention in a resort city such as Pasadena. The result is, or at least was in this case, that the newspapers seize upon the apparent bitterness of discussion and play up the controversy in headlines that remove it from the category of a technical discussion. A difference of opinion about proposed developments of this sort may be only natural but when the public is made to believe that capable engineers are in acrimonious disagreement on the major issues of some important project a feeling of uncertainty and distrust is engendered which has time and again militated against development so that none of the alternative plans are accepted or approved. Factions develop, citing this or that engineer as their champion and frequently, then, the public attempts to do its own engineering.

The Colorado River has now been surveyed for its entire length. The location, elevation, and capacity of all reservoir sites are known, as are the areas of the irrigable lands and the amounts of power involved in the several projects and their distances from the existing power markets. It may be that all factions cannot be satisfied by a decision to carry out any one or even any combination of plans. However, that does not constitute a reason for delay and argument continuing indefinitely; there is some approximation of the greatest good for the greatest number and the present urgent need is for the establishment or the recognition of authority to select and decide upon that best plan. When some commission or board vested with that authority can receive from engineers testimony calculated to aid in arriving at that best plan, then it will be in order to marshall all the facts and let the commission decide the issue.

In spite of the fact that the latest meeting has had undesirable publicity, the American Society of Civil Engineers has done commendable work in bringing the leading experts on this subject into a discussion where all technical phases of the matter can be presented and recorded, thus developing a library, as it were, of the latest and best thought on Colorado River problems. This accomplished there will be little to be gained by more discussion and delay even though all but constructive ideas could be kept in the background. On the other hand, with a public even now eager to take sides, there would be great harm in controversial discussion. Further analysis of claims and supporting data will be desirable, of course, but this should be before a capable tribunal; the urgent need now is for suitably vested authority to hear the case.

On Planning Too Far Ahead

ONE of the most necessary functions of the engineer is to plan for the future. The man in the street, the office and the store worries only about his own future. He is concerned about the prospects of his own business and his own welfare, and studies the future of the one as it will affect the future of the other. But with childlike faith he goes ahead using the public services confident that somewhere some engineer is worrying about what the demand for those services will be 25 years hence and is making the proper studies and agitating the proper public action so that when the quarter century passes the then existing community will be served equally well as, or perhaps better than, its smaller predecessor.

The engineer accepts this responsibility. He realizes he must look ahead, must prognosticate development and plan for its satisfaction. He realizes, too, how long it takes to get a large engineering project under way, whether it be private or public. And so he projects his plans far into the future. All over the country there are engineers surveying watersheds that will not be utilized for twenty years, studying topography where there will be no streets or roads for a decade, and plotting the demands of populations not yet born. Because they are doing so life for the next generation will be easier than today in spite of the growing complications of living. Such planning is the main thing that saves us from being altogether ground up in the machinery of civilization.

But the engineer in exercising this function of planning, which is after all only one of his functions, is apt to look too far into the future. He can become so concentrated in the major sweep of the curve that he cannot see its little divergences. Sometimes he so loses himself in the interest of his problem as a pure problem that he forgets its immediate need and the practical necessity of its being solved. This is a real danger that the planning engineer must seek to avoid.

The first, and possibly a minor manifestation of the fault, is commonly observed in the engineer's lack of interest in the mechanics of consummating his plan. The water-supply engineer makes his report on a proposed new system; the sanitary engineer recommends an elaborate sewage purification plan; the city planner lays out for posterity a perfect system of streets—and there their interest ends. They are planners, not publicity agents, nor prophets, nor promoters. There is the plan, they say in effect, take it or leave it; it's all one to me. How much of the delay between the plan and the completion of the plan is due to this letting things take their course or letting other people do the promoting, no one can tell. Certainly the engineer could in justice to himself and in justice to the community that he serves put somewhat more of his efforts into this promoting aspect of his work.

But a more important phase of this too far distant planning lies sometimes in the neglect of the immediate necessity. We have a very clear example of this in most of our current traffic relief schemes. The engineer likes to think that the removal or alleviation of the serious traffic congestion both in city streets and country roads is a problem for the engineer, but is it not time to observe that wherever and whenever the engineer has been called in to treat such problems, he apparently looks at it only from the long view. He considers as his major interest the possibilities of traffic movement in the next quarter or half century. In his mind's eye he cuts through streets where millions of dollars worth of property will have to be destroyed, to the future benefit, to be sure, of adjoining property, but at a still further time ahead in the future. He spends prospective millions in bypass roads and changes the whole face of our future cities with second-story streets and subways to cost millions more than the cities can now afford to pay and involving operations which he himself knows cannot possibly be agreed to by the cities for a decade or two.

To deny the utility of this kind of planning would be to deny the whole planning function of the engineer set forth in the earlier paragraphs. But nevertheless much of this planning is for our present emergency mere dreaming, dreaming which will sometime come true no doubt, but which is of little value to us in our present serious situation. The result is that traffic congestion is being solved by the police in the best temporary fashion that they can devise. With little exception they are responsible for the various signaling systems which have been installed and for the parking and traffic direction regulations which with the signaling systems constitute practically the only schemes which have been offered so far to relieve immediate city street congestion.

The obligation upon the engineer, if he is to consider himself seriously as a traffic congestion expert, is to think of the congestion of tomorrow as well as the congestion of ten years from now. Engineers are signaling experts in special fields. They are the only signaling experts. Why should not they be devoting more of their attention to the details of signal schemes? Engineers are transportation experts and the congestion in our city streets is after all only a question of transportation. Why should not some of the transportation experts get immediately to the problem of clearing up the difficulties in their individual cities? Why should not the engineering societies in these cities devote more attention to the immediate problems of traffic congestion and offer such publicity as they have under their control to force upon the city authorities immediate measures of relief?

This is only one though probably the most obvious example of too far planning ahead to which the engineer is sometimes addicted. One other example might be cited in the work of the Port Authority of New York which issued an admirable report looking to a period twenty or thirty years from now, but which three years after the issuance of that report continues to pay only academic attention to the immediate difficulties of port congestion and transportation in the metropolitan district.

Engineers have the reputation of being practical men, too practical the critics of the profession's broader ambitions say. But those who know the real ideals of engineering know that this is not so. They know that the true engineer is a dreamer, but a dreamer who takes practical means to make his dreams come true. He does not forget the obligations of the present or the near future when he is planning for the far future. He does not always neglect the microscope for the telescope. The engineer engaged in planning must always keep in mind the kind of practicability that is the distinguishing mark of the profession.

Improving Cleveland-Pittsburgh Line—Pennsylvania R.R.

Grade Reduction and Line Revision on Heavy-Traffic Division Increases Train Loads by 800 Tons, Reduces Pusher Engine Mileage and Relieves Congestion on Adjacent Division

ONE OF THE heaviest and most important of the extensive improvements on the Pennsylvania Railroad System, west of Pittsburgh, is a revision of the Cleveland & Pittsburgh Division by an eight-mile change of line with reduced grade between Summitville and Kensington, Ohio, and the reduction of grades between Hammondsville and New Salisbury, together with facilities at the latter place for pusher service on a shortened maximum grade. These works, which also complete the double tracking of this division, have been made for the double purpose of improving operating conditions on the C. & P. Division and of relieving the congestion of traffic on the Eastern Division, which intersects it. These operating conditions, which form the economic basis of the improvement, are described more fully later. Fig. 2 gives views of the construction work; Fig. 1 is a map of the lines affected by the improvement and Fig. 3 shows the profiles of these lines.

The Cleveland & Pittsburgh Division has an extremely heavy traffic both in density and weight of trains, for it carries coal north from the mining district for lake shipment and carries iron south from the lake terminal at Cleveland to the great iron and steel district of which Pittsburgh is the center. The new work is on that part of the line climbing out of the Ohio River valley. On the old single-track line between Summitville and Kensington, a distance of seven miles, there were grades of approximately 1 per cent in both directions. The new double-track line, which is 2,600 ft. shorter, has maximum grades of 0.3 per cent, compensated for curvature. Its sharpest curves are 2 deg. This line also eliminates all highway crossings at grade. Fig. 4 shows a plan and profile of the two lines.

Construction Work—Heavy grading was involved, requiring more than 1,000,000 cu.yd. of excavation; about 22 per cent of this amount was solid rock, for which well drills were used in putting down the blast holes. With the cuts approximately balancing the fills, all excavated material was loaded by steam shovels, hauled away by both standard-gage and narrow-gage equipment and dumped from temporary trestles to form the fills. An allowance of 12 per cent was made for shrinkage in fills. The heaviest work was at Summit Cut, Fig. 2, where the line is in excavation for about 4,000 ft., with a maximum depth of cut of 85 ft. As this was on the diversion, the work did not interfere with the operated line.

In fact, work trains and dump-car trains were kept entirely clear of the main tracks, being handled by the contractor's locomotives on construction tracks built along the full length of the improvement. Since no widening of old single-track fills was required and there was no grade reduction on the original location, it was practicable to carry on all construction work independent of main-line traffic.

Track and Structures—For the subgrade or roadbed, the finished width is 35 ft. on fills and 46 ft. in cuts. The roadbed is covered with a 12-in. bed of cinders as sub-ballast, upon which is stone ballast 12 in. deep under the ties. All tracks are laid with 100-lb. rails of the Pennsylvania R.R. section in 33-ft. lengths, spliced with 24-in. angle bars having four 1-in. bolts. The rails are secured by ordinary cut spikes to ties spaced twenty to a 33-ft. rail length. Turnouts have 18-ft. switch rails and No. 10 rigid bolted frogs. Rail anchors are used on the 1 per cent pusher grade and on the new location.

Most of the under-bridges and culverts are of reinforced concrete, with arches or deck slabs according to the size of opening and depth of cover. A two-span

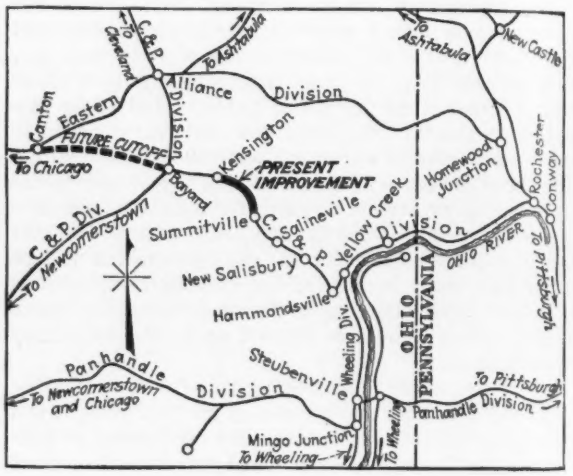


FIG. 1—C. & P. DIVISION AND RELATED LINES

concrete deck bridge over a highway is shown in Fig. 2 and an arched culvert in Fig. 6. It will be noticed that the flat surfaces of the side and wing walls and portals of the concrete structures are marked with horizontal scores or grooves to improve the appearance, while the arch rings are also defined on the portals. For carrying highways over cuts there are two steel bridges, a 140-ft. steel deck-truss span and an 87-ft. girder span. The erection of the truss bridge is shown in Fig. 5.

Operating Conditions—In this work the engineering and construction features are probably of less importance than the operating conditions which led to the improvement. For a clear understanding of the situation, it is necessary to refer to the general map of the Pennsylvania R.R. System in the territory immediately west of Pittsburgh, Fig. 1, and to the profiles shown in Fig. 3.

The Eastern Division (a portion of the main line between Pittsburgh and Chicago) runs from Pittsburgh northwest for about 35 miles to Homewood Junction and then turns almost directly west through Alliance and Canton, Ohio. Important freight yards with engine terminal facilities and repair shops are located at Conway and Canton, distant 23 miles and 98 miles, respectively, from Pittsburgh. This division has four tracks for the greater part of the distance to Canton, but there are several stretches of either two or three tracks. The ruling grades are approximately 1 per cent in both directions between Pittsburgh and Alliance; between Alliance and Canton they are 0.8 per cent against east-

bound and 0.7 per cent against westbound traffic. These grades include compensation for curvature at the rate of 0.04 per cent per degree of curve.

At Rochester, two miles west of the Conway yard, the Cleveland & Pittsburgh Division diverges from the Eastern Division and runs southwest along the Ohio River to Yellow Creek; thence it runs north to Cleveland, crossing the Eastern Division at Alliance. The distance from Conway to Alliance is 70.6 miles by the C. & P. Division and 60.7 miles by the Eastern Division.

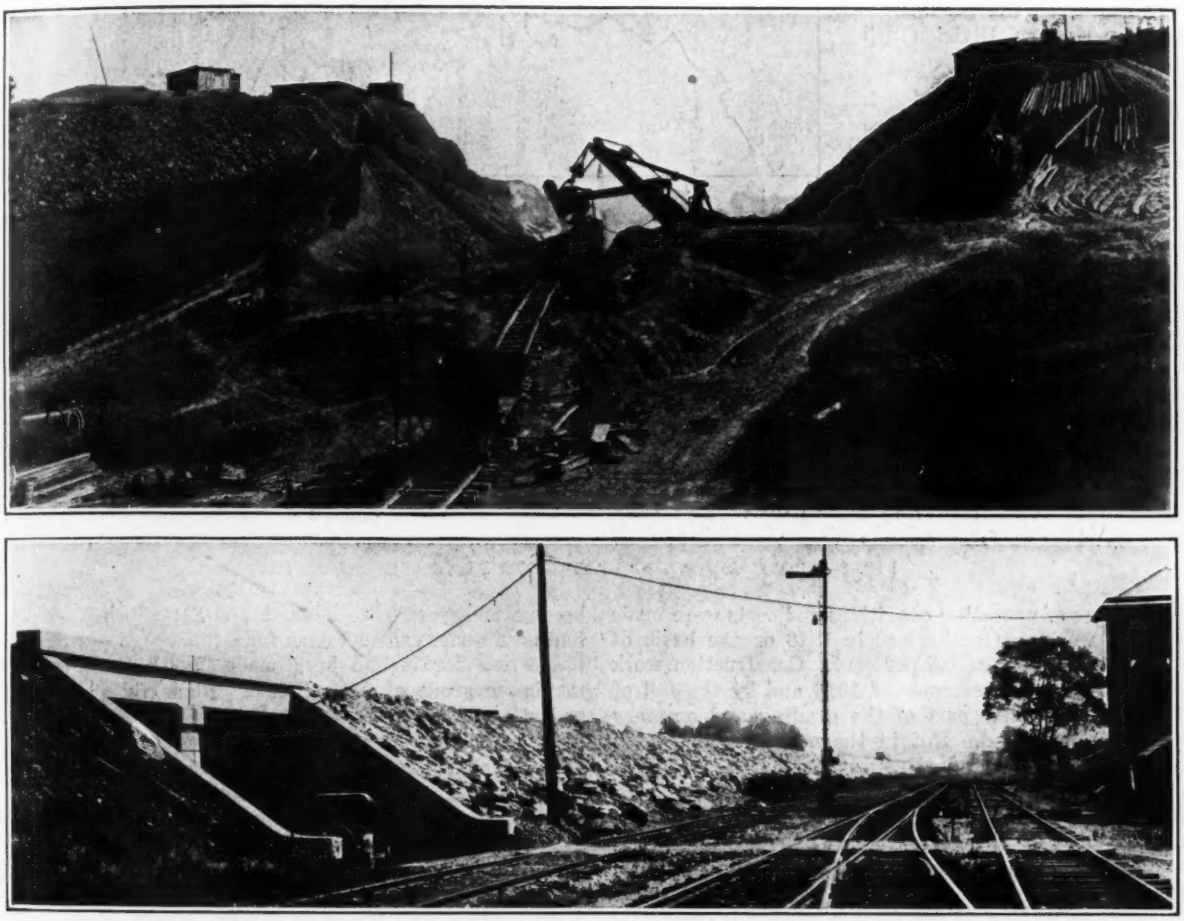


FIG. 2—GRADE REDUCTION ON CLEVELAND-PITTSBURGH DIVISION, PENNSYLVANIA R.R.
Above: summit cut 4,000 ft. long with maximum depth of 85 ft. Below: new diversion and highway bridges at left: Original line at right. The "KN" signal tower, which is at right of tracks, is near the north end of the diversion.

On the Cleveland & Pittsburgh Division the ruling grade northward, between Rochester and Alliance, is 0.5 per cent, with the exception of nine miles of 1 per cent grade from New Salisbury to Summitville. This grade, known as the "Salineville Hill," is operated by pusher service. Prior to the completion of the improvements between Kensington and Summitville it was necessary to use pusher engines from Yellow Creek to "KN" tower, north of Kensington, a distance of 24.3 miles; requiring 48.6 pusher-engine-miles per train westbound. It is now necessary to use pusher engines only from New Salisbury to Summitville, 10 miles, the engines making a round trip of 20 miles, thus giving a saving of 28.6 pusher-engine-miles per train northbound.

At Yellow Creek, the C. & P. Division is joined by the Wheeling Division, which runs south along the Ohio River, tapping the extensive Belmont coal fields of southeastern Ohio and serving important industrial establishments at Steubenville, Martins Ferry, Bridgeport, Bellaire and Wheeling. The grades on this section of road are nowhere in excess of 0.5 per cent. At Mingo Junction, 20 miles south of Yellow Creek, is a connection with the Panhandle Division, and here is provided a modern freight yard with engine terminal facilities. This yard is used as an assembling yard for coal originating down river and also for the industrial business.

From the profile of the C. & P. Division from Conway to Cleveland, at the top of Fig. 3, it will be noted that from Bedford to Cleveland the southbound grades are in excess of 0.5 per cent. Between Alliance and Bedford there are three grades in excess of 0.5 per cent against northbound traffic, at Limaville, Atwater and Rootstown. There are also three similar grades against southbound traffic, at Bedford, Hudson and Rootstown. These grades can be reduced to 0.5 per cent and, at somewhat greater expense, to 0.3 per cent.

Economics of Grade Reduction—When the Summitville-Kensington change of line was planned in 1909 it was thought that the expense of reducing the grades below 0.5 per cent at this point was not then warranted and would not be warranted until such time as the remaining higher grades on the C. & P. Division could be reduced, or until the traffic over this portion of the road should increase to such an extent that the savings

due to the lower grades would justify the expenditure required.

On the other hand, it was argued that the grade between Summitville and Kensington should not be over 0.3 per cent, so that the slow freight business of the Eastern Division could be diverted from that division and sent over the C. & P. Division between Rochester and Alliance, thus avoiding the heavy grades on the Eastern Division between these points. These grades are shown on the profile of the Eastern Division between Conway and Canton, in Fig. 3. A profile of the line between Conway and Canton, by the C. & P. Division, is also shown.

and repair facilities, just east of Canton and fifteen miles west of Alliance.

It was then possible to route advantageously a portion of the Eastern Division business over the C. & P. Division. This added traffic furnished an argument for a further grade reduction, particularly as it seemed probable that, with the growth of business, the construction of a cutoff from Bayard to Canton would become necessary (see Figs. 1 and 3). Such a cutoff had been under consideration for a number of years and a location for it had been made, on the basis of a maximum grade of 0.3 per cent. Plans for a general reduction of grades on the Eastern Division to a maximum of 0.3 per cent had been worked out and the route through Canton and Bayard and over the C. & P. Division was a part of one of the schemes considered of especial merit; a profile shown in Fig. 3.

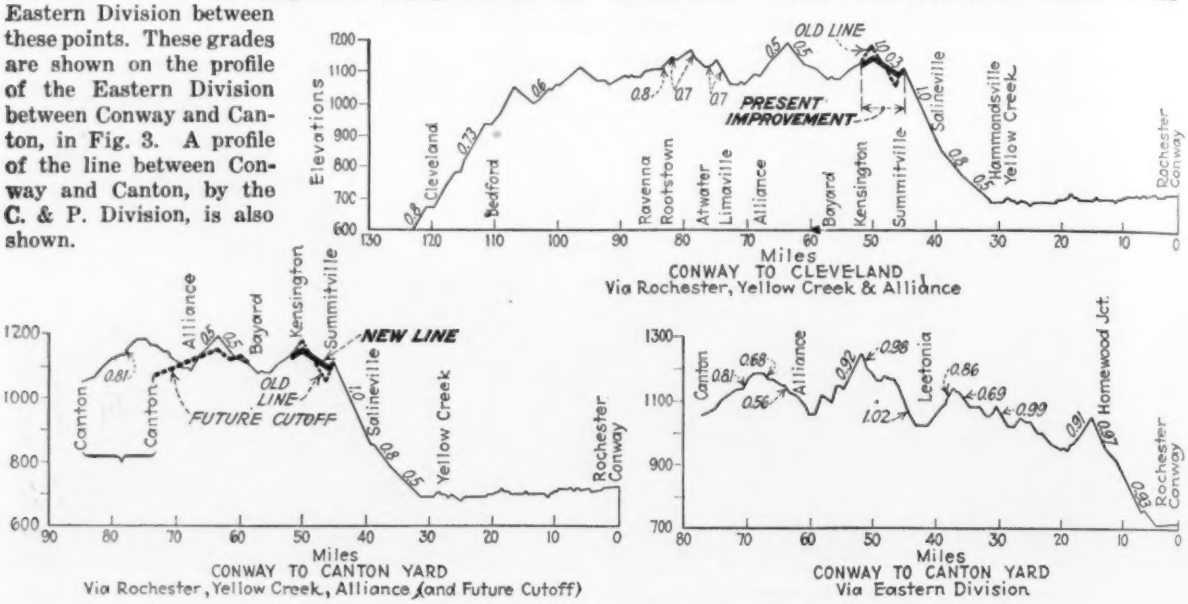


FIG. 3—PROFILES OF LINES AFFECTED BY GRADE REDUCTION

Analyses of operating conditions and costs were made and the work was authorized in 1916 on the basis of a maximum grade of 0.5 per cent. Construction work was started in the summer of 1916 and by the fall of 1917 a considerable part of the grading and masonry had been completed. But in the meantime operating conditions had changed. Business on the Eastern Division increased to such an extent that, coupled with the increasing demand for an actual eight-hour day instead of the basic eight-hour day in road train service, it became necessary to shorten runs between Conway and Crestline, 166 miles west. This resulted in the construction of the Canton yard, with terminal

The work done on the Summitville-Kensington relocation had been carried out in such a manner that the change from 0.5 per cent to 0.3 per cent grade could be made without any waste of money already spent, and

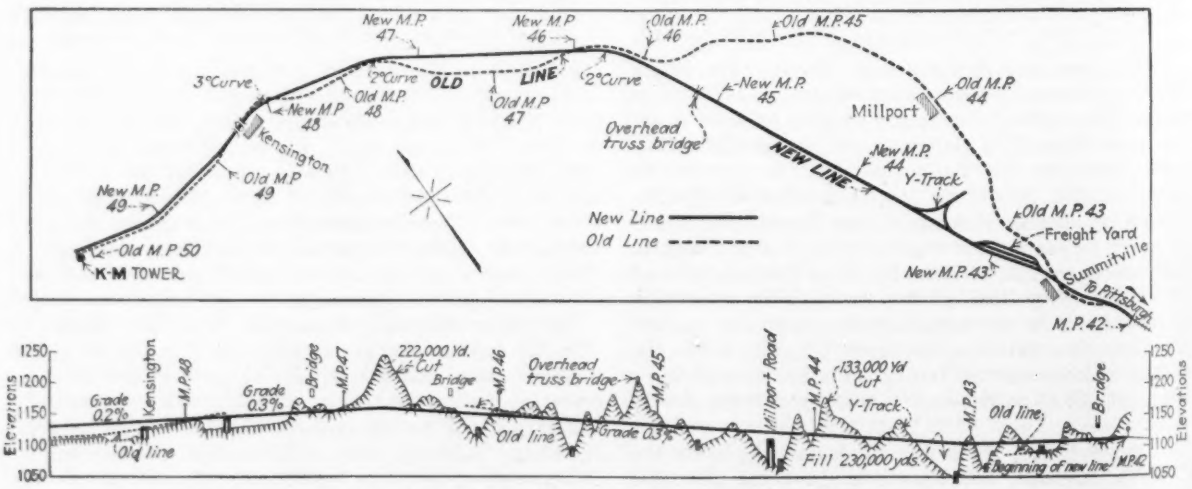


FIG. 4—SUMMITVILLE-KENSINGTON IMPROVEMENT

this change was authorized in 1917. Had the work been completed as originally planned, there would have been available southward from Summitville to Conway (44 miles) and from Summitville to Mingo Junction (39 miles) a railroad with actual ruling grades of 0.3 per cent, having grades northward of 0.3 per cent except for the pusher grade from Hammondsville to Summitville. North of Summitville the ruling grade in each direction would have been 0.5 per cent except for the grades north of Alliance referred to above.

Advantages of 0.3 Per Cent Grade—In order to take full advantage of the 0.3 per cent grade south of Summitville for trains from Alliance to Conway or Mingo Junction, it would have been necessary to construct a fill-out yard at Summitville, to enable southbound trains to pick up the additional tonnage. By making the change from 0.5 per cent to 0.3 per cent on the relocation, the 0.3 per cent grade was extended to Bayard, a distance of 12 miles, at which point there already existed a yard with ample facilities for present traffic, and which could be readily expanded to care for further growth.

A further reason for favorably considering the change to 0.3 per cent was that there existed a very evident possibility that at no very distant future the grades on the C. & P. Division north of Alliance must be reduced, and the growing traffic would eventually justify the adoption of a profile with ruling grades of 0.3 per cent. This would leave the grades between Alliance and Bayard as the only obstacles to a full train loading in both directions for a grade of 0.3 per cent, pusher engines, of course, being required northbound on Salineville Hill. These grades could, at reasonable expense, be reduced when advisable, and in the meantime could be operated with pusher engines. With all the grades on the C. & P. Division reduced as outlined above, it would be feasible to provide for road freight runs with trains loaded for 0.3 per cent grades between Cleveland (Bedford Yard) and Conway or Mingo Junction, distances of 111 and 105 miles, respectively.

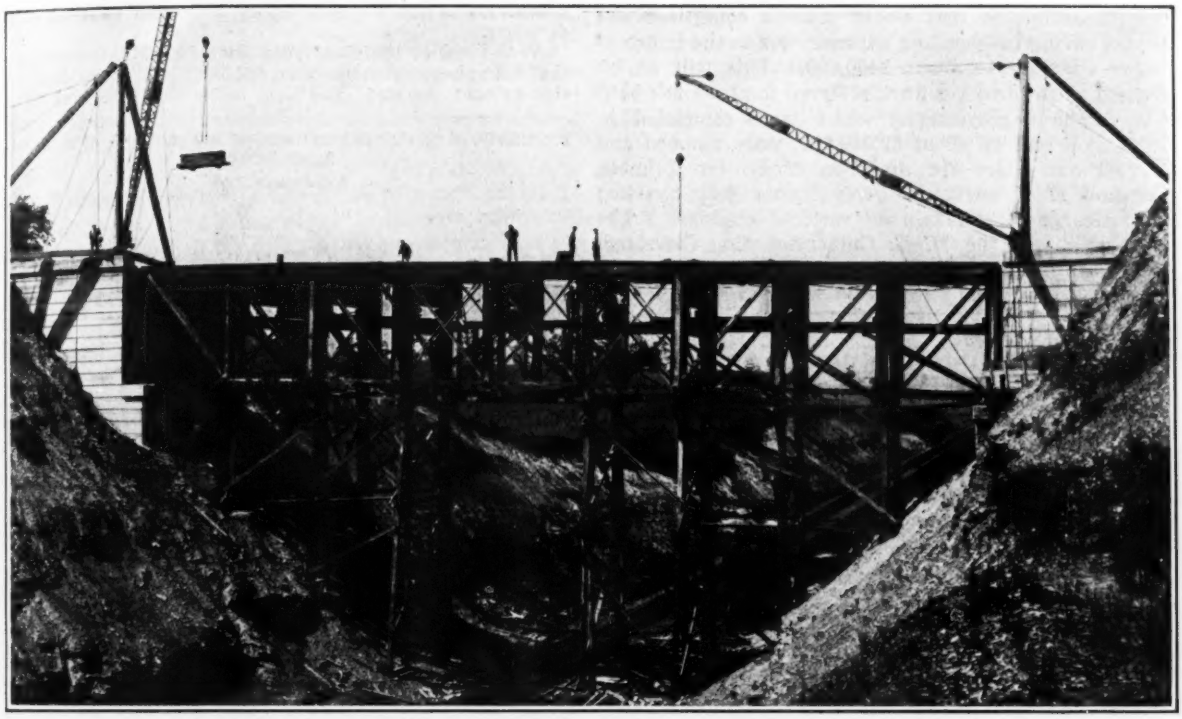


FIG. 5—ERECTING HIGHWAY BRIDGE OVER DEEP RAILROAD CUT

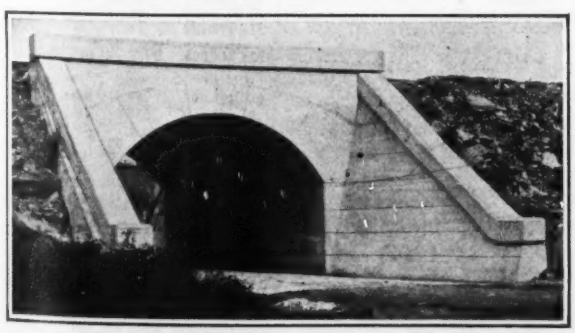


FIG. 6—TYPICAL CONCRETE ARCHED CULVERT
Note the horizontal grooves relieving flat surfaces of wing and end walls.

The full advantage of the 0.3 per cent grade is not yet obtained and cannot be until the other grades on the C. & P. Division have been reduced and the Canton-Bayard cutoff is constructed. Nevertheless, the improvements have made it possible to route a large amount of Eastern Division business over the C. & P. Division, avoiding the heavy grades of the former. They have also made it possible to increase the loading of C. & P. Division trains from 3,760 tons to 4,570 tons, with an adjustment factor of 10 tons per car. These train loads are for two classes of engines of the 2:10:2 type, having tractive power of 90,000 and 85,000 lb. respectively. The amount of pusher engine mileage has also been reduced considerably. The traffic on this part of the C. & P. Division comprises about three passenger trains and fifteen freight trains each

way daily. The annual tonnage now moved over this part of the C. & P. Division amounts to 24,184,000 tons, divided as follows:

	Eastbound Tons	Westbound Tons
C. & P. Division trains	6,667,000	9,094,000
Eastern Division trains	4,021,000	4,402,000
Total	10,688,000	13,496,000

It is estimated that under present conditions the annual saving in operating expenses due to the improvements amounts to about $400,000. This will be increased when the other work referred to above has been done. The improvements, which were completed in 1923, at a cost of about $2,000,000, were planned and carried out under the direction of Robert Trimble, assistant chief engineer, Pennsylvania R.R. System; with George M. Sauvain as resident engineer. The contractor was the H. E. Culbertson Co., Cleveland, Ohio, with B. L. Hundley as superintendent of the work.

Highway Indebtedness Compared With Total Debt

Outstanding Road Bonds Aggregate Only Fourteen Per Cent of the State and Local Bonded Indebtedness

Extract from an article in "Public Roads" for May, 1924, by Henry R. Trumbower, Economist, U. S. Bureau of Public Roads.

AN INQUIRY made by the United States Bureau of Public Roads into the financial status of our rural highways and the recent reports of the United States Census Bureau relative to state and local taxes and public indebtedness shows that for the country as a whole the indebtedness incurred on account of rural highway expenditures accounts for but a small part of the public indebtedness to which the states and their subdivisions have obligated themselves.

At the end of 1921 the total amount of highway bonds outstanding was $1,222,312,300. Of the whole issue 72 per cent are represented by local bonds, the obligations of counties, townships, and districts; 28 per cent are the obligations of state governments.

There are only two states in the whole country which have no highway bonds of any kind outstanding, state or local. These are North Dakota and Vermont. All the other states have local bonds outstanding, with the exception of Colorado which has issued state highway bonds but has no local bonds issued for that purpose.

Over half of the states, 27 in number, have no state highway bonds outstanding. New York has the largest issue outstanding, both state and local, amounting to $121,681,100; California is a close second with $101,258,000.

The United States Census Bureau has reported the total amount of bonds issued for all purposes by states, counties, and all other subdivisions (including cities, villages, townships, and school districts). For the year 1922, which is the closest information which can be compared with the highway indebtedness, the total indebtedness, less the sinking fund assets set aside to meet such debts, was $8,695,906,000. This total indebtedness, which may be regarded as the net amount, is divided as follows:

	Amount	Per Cent
State	$936,414,000	10.5
Counties	1,255,226,000	14.5
All other subdivisions	6,504,266,000	75.0
Total	8,695,906,000	100.0

It will be observed that by far the major part of this total debt, or 75 per cent, is the obligation of cities, villages, townships, and school and other districts; the state and county share was but 25 per cent.

In order to make a closer comparison with the indebtedness for highway purposes, the debt of the counties and all other subdivisions, amounting to $7,759,492,000, may be called local. The direct comparison follows:

	Togal Indebtedness	Highway Bonds—Amount	Highway Bonds—Per Cent Of Total Debt
State	$936,414,000	$345,574,100	37
Local	7,759,492,000	876,738,200	11
Total	8,695,906,000	1,222,312,300	14

According to this it is shown that the total highway bonds of the country amounts to 14 per cent of the total indebtedness of the states, counties, and other political subdivisions.

At the end of the fiscal year June 30, 1923, the debt of the federal government was $22,525,773,000. Adding to this amount the state and local indebtedness we get $31,-

PERCENTAGE OF HIGHWAY BONDS OF TOTAL STATE AND LOCAL BOND DEBT

	Total Debt 1922	Highway Bonds—At End of 1921	Highway Bonds—Per Cent of Total Debt
New England States			
Maine	$42,457,000	$6,439,300	15.2
New Hampshire	16,604,000	570,100	3.4
Vermont	11,994,000	.....	.....
Massachusetts	326,245,000	26,820,800	8.2
Rhode Island	49,893,000	2,952,000	5.9
Connecticut	100,954,000	*400,000	.4
Total	*$548,147,000	$37,182,200	6.8
Middle Atlantic States			
New York	$1,683,820,000	$121,681,100	7.2
New Jersey	382,001,000	25,833,000	6.7
Pennsylvania	550,365,000	†50,000,000	9.1
Total	$2,616,186,000	$197,514,100	7.5
East North Central States			
Ohio	$670,338,000	$70,936,500	10.4
Indiana	152,840,000	62,415,900	41.0
Illinois	364,019,000	20,617,300	5.6
Michigan	361,779,000	55,234,200	15.3
Wisconsin	104,523,000	10,201,600	9.8
Total	$1,653,499,000	$219,405,500	13.3
West North Central States			
Minnesota	$269,607,000	$21,402,600	8.0
Iowa	151,911,000	25,677,800	16.8
Missouri	118,276,000	14,942,600	12.6
North Dakota	40,266,000	.....	.....
South Dakota	50,554,000	3,649,000	7.2
Nebraska	97,819,000	2,848,000	2.9
Kansas	123,470,000	9,182,400	7.4
Total	$851,903,000	$77,702,400	9.1
South Atlantic States			
Delaware	$22,453,000	$7,144,000	31.8
Maryland	120,954,000	18,212,900	15.2
Virginia	119,494,000	14,936,300	12.5
West Virginia	70,512,000	37,727,900	53.5
North Carolina	182,711,000	55,808,500	30.6
South Carolina	65,010,000	13,081,000	20.0
Georgia	64,045,000	15,659,000	24.4
Florida	98,243,000	24,130,200	24.6
Total	$743,422,000	$186,699,800	25.1
East South Central States			
Kentucky	$50,324,000	$7,135,800	14.2
Tennessee	142,159,000	28,693,500	20.2
Alabama	75,189,000	8,758,500	11.6
Mississippi	111,499,000	37,912,400	34.0
Total	$379,171,000	$82,500,200	21.8
West South Central States			
Arkansas	$91,279,000	$50,955,700	55.7
Louisiana	126,946,000	28,571,400	22.5
Oklahoma	129,977,000	11,547,600	8.9
Texas	356,342,000	96,517,900	27.1
Total	$704,544,000	$187,592,600	26.6
Mountain States			
Montana	$65,229,000	$9,775,800	14.9
Idaho	61,693,000	19,772,200	32.0
Wyoming	19,128,000	3,745,000	19.6
Colorado	99,645,000	2,000,000	2.1
New Mexico	25,010,000	2,001,100	8.0
Arizona	44,973,000	18,501,000	41.2
Utah	50,041,000	11,785,200	23.6
Nevada	7,861,000	1,438,000	18.3
Total	$373,580,000	$69,018,300	18.5
Pacific States			
Washington	$169,063,000	$20,547,900	12.1
Oregon	137,177,000	42,891,300	31.2
California	519,214,000	101,258,000	19.5
Total	$825,454,000	$164,697,200	19.8
Total and average	$8,695,906,000	$1,222,312,300	14.0

* Complete data not available. † No data for local bonds.

221,679,000 as the total indebtedness of the country. Of this amount $1,222,312,300 was represented by highway bonds, or 3.9 per cent.

A comparison of the amount of highway bonds outstanding and the total debts of states and their local subdivisions is presented in the accompanying table, according to geographic divisions and states.

Unnecessary Exposure to Danger Not Justified in Law

Court Declares That Unnecessary Exposure to Danger by Civil Engineers Relieves Employers from Liability

BY LESLIE CHILDS
Attorney, Greenfield, Ind.

IN THE performance of the duties of a civil engineer an exposure to extreme danger may upon occasions become necessary if the engineer in question is true to his trust. In cases of flood, upheavals of nature, and like situations an engineer may be called upon to take his life in his hands in the line of his employment. It may be stated broadly that when, under such circumstances, an engineer loses his life or suffers injury his employer will ordinarily be liable for the loss sustained. This liability of an employer, however, is usually grounded on the necessity of the situation, and unless the engineer suffering injury in a case of this kind can show that the service was necessary in the performance of his duties he may forfeit his right to compensation for the injury suffered. If he exposes himself to unnecessary danger, his employer may be relieved from liability for injury. The application of this rule of law is illustrated in a striking and interesting manner in the tragic case of Gulf, Colorado & Santa Fé Railway Co. *vs.* Leatherbury, a Texas case which arose under the following facts.

A Case in Point—In September, 1921, there was an overflow on Little River, in Milam County, Texas. This flood covered about 4,800 ft. of the Gulf, Colorado & Santa Fé Railway Co.'s track, washing most of it away, and washing out about 3,200 ft. of the dump upon which the track was laid. The water was so high on Saturday, Sept. 10, that nothing could be done toward repairing the dump at that time. The following morning a work train was sent from Temple, Texas, to begin repairing the damage. This train brought, among other things, a 16-ft. boat, which had been built and used in 1913 for flood situations of this kind and which had been out of the water in the shops at Temple since 1913. It was repaired the night before it was taken on this trip.

When the work train arrived at the washout the Little River was still at flood stage, more than a mile wide, and the current was very swift. In fact, from the evidence, it appears that to venture across it at that time in such a boat as has been described could be termed at least very imprudent. And further it appeared that two men were drowned in previous years in similar undertakings.

However, in the face of this situation, and the warnings of other railway officials and friends, on the afternoon of Sept. 11, F. W. Leatherbury, division engineer, and Maynard Robinson, master mechanic at Temple, undertook to go in this boat to the ballast deck bridge, a distance of 2,600 feet from the water's edge. The ostensible purpose of the trip, on Leatherbury's part at least, was to enable him, in his capacity of division engineer, to estimate the damage and make a report relative to the materials needed for repairs. Leatherbury and Robinson rowed upstream for a distance in the eddying water and then headed toward the main current. Before they reached their objective their boat was in some way caught in the current and both were drowned.

Action for damages was brought by Mrs. Leatherbury, as community administrator, against the railway company for the death of her husband. In this action Mrs. Leatherbury alleged in substance that her husband lost his life in the performance of his duty, and that the tragedy was caused by the negligence of the railway company in furnishing him with a boat which was defective and not suited for navigation in swift waters.

In reply to this the railway company alleged, among other things, that Leatherbury had made the trip in violation of the orders and advice of his superior officers; that the trip when undertaken was not a part of his duties; that there was no necessity for him to go upon the waters at that time, as nothing could be gained by it. The contention was that under the circumstances Leatherbury assumed all risk of the venture himself, and that the railway company should not be held liable.

Upon the trial of the cause in the lower court before a jury a verdict was rendered in favor of Mrs. Leatherbury in the sum of $25,000. The railway company prosecuted an appeal from judgment rendered thereon to the higher court. Here in passing upon the question of whether or not, in the light of all the circumstances, Leatherbury had assumed the risk, it was said:

> Leatherbury was not sent out by any one in the employ of the appellant [railway company]. It is not substantially controverted that it was not necessary for him to go out to this bridge that afternoon, and that the information he desired, obtained the next morning after the flood waters had subsided, would have served his purpose equally well.
>
> There was no substantial dispute as to what his general duties were. But these duties did not require him to risk his life in their performance, even if it had been important for him to get the desired information as soon as possible.
>
> In the light of all these undisputed facts, we think the evidence was such that no reasonable minds could differ upon its conclusiveness that, if he did not go in open disobedience of the orders or instructions of his superior officers, no man in the exercise of ordinary care and prudence would have risked his life on such a trip when the dangers were obvious and must necessarily have been known to both Leatherbury and Robinson. Clearly, we think, Leatherbury and Robinson assumed the risk of their daring, hazardous, and unwise undertaking.

In conclusion the higher court reversed the judgment rendered in the court below, and ordered a judgment rendered in favor of the railway company, holding, as outlined in the opinion, that under all the facts and circumstances Leatherbury had exposed himself to an unnecessary danger in such a manner as to deprive his dependents of right to damages for the loss of his life.

It is obvious that the foregoing Texas decision is one of force and value on the point decided. In the light of the facts and holding of this case it is plain that an engineer is bound to exercise care and prudence in the performance of his duties if his employer is to be held liable for a resulting accident. In other words, he cannot assume unnecessary risk, fly directly in the face of obvious danger, and rely on the law to compel his employer to assume liability if accident or death befall him. Truly the case reviewed is one that every engineer may with profit have in mind when tempted to go beyond the requirements of his service in a hazardous undertaking.

Cantilevering a Heavy Bridge Span In Northern Quebec

Rapid Current Leads to Use of Unusual Method on Railroad Approach to Saguenay River Power Development

By J. P. Chapleau
Engineer, Quebec Development Co., St. Joseph D'Alma, P. Q.
and C. M. Goodrich
Designing Engineer, Canadian Bridge Co., Walkerville, Ont.

SPECIAL conditions surrounding the construction of a railroad bridge across the Saguenay River, in northern Quebec, a few months ago led to a rather remarkable use of the cantilever erection method. A 220-ft. double-track span was cantilevered for its full length from a 90-ft. approach span, because of the rapid current in the river. The substructure work for this bridge also was interesting, being done in very cold winter weather, with heated forms.

Construction of the 480,000-hp. Isle Maligne power development on the Saguenay River, near St. Joseph d'Alma, P. Q., by the Quebec Development Co., began early in January, 1923. An 11-mile railway line had first to be built from Hebertville, on the Canadian National Ry., for bringing in supplies and equipment. This line crosses Bedard River and three channels of the Saguenay River—two branches of the Petite Decharge and the right channel of the Grande Decharge, effluents of Lake St. John, which join just below the power development site. The bridge over Grande Decharge, which is directly at the site, is the largest of these crossings, and is the one to which this article relates. Fig. 1 shows the bridge completed.

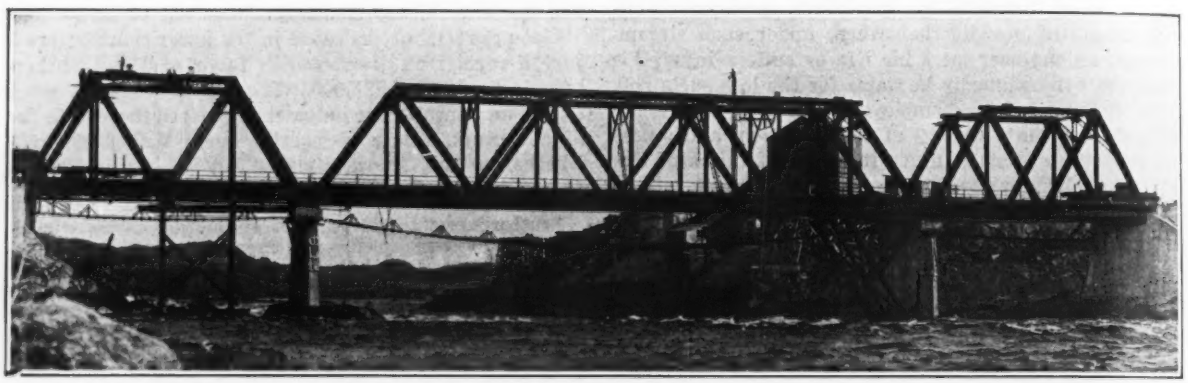


FIG. 1—COMPLETED SAGUENAY RIVER BRIDGE
Erection was begun at right-hand end, by building 90-ft. approach span on falsework; the 220-ft. main span was cantilevered from the approach span, and after its completion the left-hand approach span was erected.

At the point of crossing the channel is narrow, and the bridge consists only of two 90-ft. approach spans and a channel span of 220 ft. The current is rapid and deep. Cofferdams were possible only near the shores and falsework for the center span entirely impossible. The piers and abutments were located so as to eliminate water at the low stages as far as possible; only one of the piers came within the water area. Solid rock was reached in all cases only a few feet below the surface. The only interesting feature of the foundation excavation was the use of frozen sides instead of cofferdams and shoring.

A cableway was erected on the center line and the mixing plant located under it on the west side. Owing to the low temperature, it was necessary to heat the water and sand in order to get the mix into the forms without freezing. Both the sand and water were made as hot as possible and the concrete reached the forms above freezing. Double forms were built and covered on the outside with tar paper (Fig. 2). A system of steam piping was carried along as the forms were built and steam was used to keep the area between warm for a period of ten days after pouring. The top surface was covered with tarpaulins and live steam admitted. With these precautions, and leaving the forms in place until April, concrete was obtained that is first-class in every respect, in spite of very low temperatures (see temperature chart in Fig. 2).

Owing to grading of earth portions of the line, tracklaying and the erection of the three steel bridges west of the Grande Decharge, track did not reach the site until Aug. 18. Erection started immediately thereafter.

The water at this point is extremely swift and the cofferdam on the other side of the Isle Maligne, which closes that side and makes possible the work for the foundations of the power house proper, has more than doubled the water in the right-hand channel, where the bridge is placed, and has resulted in a current so swift that at one time the water immediately above the bridge was apparently about 8 ft. higher than the water immediately below. It was necessary to cantilever the 220-ft. span from the 90-ft. span, falsework being used for both 90-ft. spans.

The spans are double-track, with trusses 31 ft. 6 in. apart, and they are proportioned for E-40 loading under the recently adopted specifications of the Canadian Engineering Standards Association. During the time that construction work is going on both tracks will be used, and across them will go trains of dump cars, serving a concrete mixing plant containing two 4-yd. mixers. On each side of the bridge there is a 30-in walkway.

The weight of the main span is 955,000 lb., of which less than ten tons is added to take care of the erection stresses. The flanking span, which is used only as a simple span, weighs 268,000 lb., while the span from which the long span is cantilevered weighs 333,000 lb. It will be seen, therefore, that less than 35 tons is the amount of material added to the normal 90-ft. span to enable it to do its work as an anchor span. A saving of perhaps 30 tons could have been made by using two single-track deck plate-girder spans instead

of the 90-ft. span at the far end, but the site is one of singular beauty, and the work is monumental in character, and it was felt that it was logical to make the flanking spans alike in order to make the bridge symmetrical and better the appearance of the crossing.

The spans themselves are of standard type and make-up. The top chords of the center span have 30-in. cover plates, 26-in. side plates and four 6x6-in. angles. Attention may be called to the omission of verticals at the center of the 90-ft. spans, and to the use of top laterals which run diagonally from hip to hip.

The abutment was designed so that an anchorage on two 200-ton Dudgeon jacks; and then to lower about 18 in., in three lifts. When the end of the span was jacked up 4½ in. and the first attempt made to take out the bolts in the tie, it was found that most of them could be pushed out with the fingers.

Work on the 220-ft. span started on Sunday, Sept. 15. The bent was not completed until the 16th, chiefly owing to the difficulties of landing it properly and securing it in place against the rush of waters coming just over the sill of the bent. The first steel in the main span was placed on Sept. 17, and the span was landed on Sunday, Oct. 14. At this time practically all the

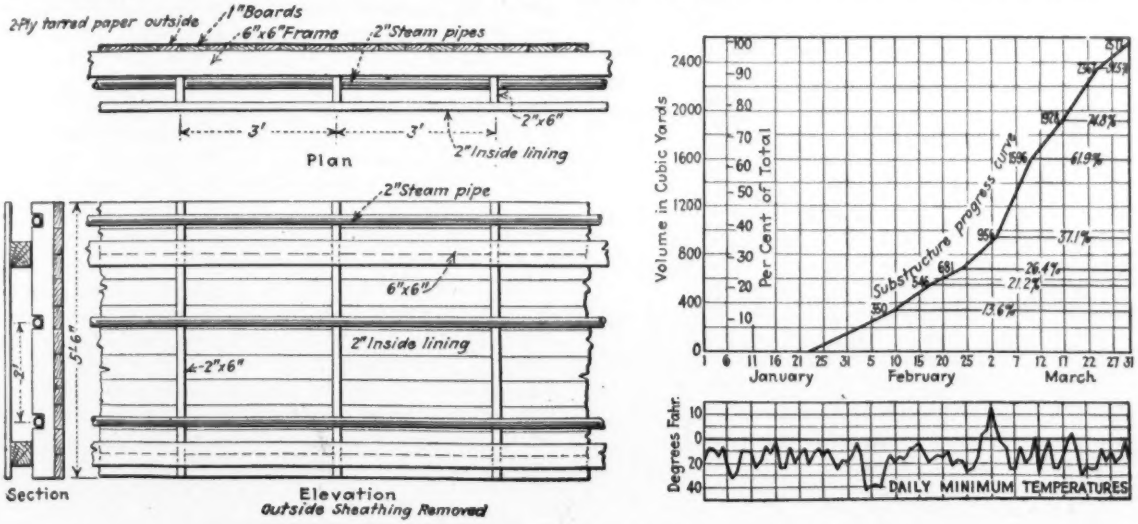


FIG. 2—DOUBLE-WALL HEATED PIER FORMS AND TEMPERATURE CHART

at the shore end of the 90-ft. anchor span should carry an uplift of 200 tons; the balance of the uplift, or a total of about 290 tons, was taken by piling railroad rail close to the trusses between the end floorbeam and the first interior floorbeam on each side.

In order to start the erection of the cantilever span a five-legged bent sloping at about 40 deg. was lowered to a ledge on the edge of the main pier at a little below water level, the upper end coming under the bottom chords at the first interior floorbeam. After the first pieces of the bottom chords of the main span had been put in place and the verticals and end posts assembled, ties were put in between the hip points and the work proceeded as cantilever erection, quite independent of the temporary bent, although this was allowed to remain until the span was landed.

Riveting of the main span proceeded as closely behind the erection as was conveniently possible, and all four stringers for the two railway tracks were put in and riveted complete, including their lateral bracing.

The stresses used in the steel during the time of erection at no time exceeded 20,000 lb. per square inch, properly reduced for compression, and 22,000 lb. per square inch in tension. The tie was composed of stringers from the 90-ft. span of the far end of the bridge, with necessary material to connect them together and to connect them to the trusses. The compression member at the bottom was a short built piece bearing against the pins in the ends of the adjacent bottom chords. No adjustment was used; the length of the tie was so taken that when the far pier was reached it was only necessary to jack up the end of the main span riveting was completed, the exceptions being a few stringer and floorbeam rivets in the last panel.

The erection of this bridge, as well as bridges on two other crossings over the Petite Decharge of the Saguenay, was done by the Canadian Bridge Co., Ltd., while the steel for the Bedard River crossing was furnished by the Dominion Bridge Co. and the erection was done by forces of the Quebec Development Co.

The Saguenay piers and abutments were built by W. I. Bishop, of Montreal and those for the Bedard River by Cyprian Gagnon, of St. Joseph d'Alma, P. Q.

W. S. Lee is vice-president and chief engineer of the Quebec Development Co. The construction force is in the immediate charge of F. H. Cothran, vice-president. D. F. Noyes is superintendent, H. G. Cochrane and J. P. Chapleau are engineers, and S. F. MacDougald is master mechanic.

Activated-Sludge Tests at Glasgow

At the annual inspection early in June of the sewage-works of Glasgow, Scotland, Bailie Thomson, convener of the sewage committee, is credited by *The Surveyor* of June 13 as saying that before many months it was hoped that the city would be able to learn from an experimental plant at Shieldhall what can be accomplished by "compressed-air action in activated-sludge treatment." Good results have been had from mechanical action by means of paddle wheels, but this process, according to *The Surveyor's* account of Mr. Thomson's remarks, "had its limitations, and in Glasgow they desired the best, most modern methods of treatment."

Power Possibilities of the South Fork, Flathead River

Large Reservoir Site Makes Economic Development of Power Possible—Increased Height of Flathead Lake Objectionable

By Benjamin E. Jones and Edward E. Jones
Hydraulic Engineers, Department of the Interior, Geological Survey, Washington, D. C.

On the west side of the Continental Divide in northwestern Montana the Flathead River, coming out of Flathead Lake, joins the Clark Fork, which in turn flows north into the Columbia River. On account of its altitude and the size of Flathead Lake, the Flathead

FIG. 1—MAP OF VALLEYS OF FLATHEAD RIVER AND CLARK FORK OF THE COLUMBIA

River has been studied frequently with the idea of developing storage to improve its flow and that of Clark Fork and of the Columbia. Such storage would be particularly advantageous to the 300 ft. of head between the lake and the junction with the Clark Fork and to a less extent to four sites below the junction, having a total head of 732 ft.

Flathead Lake, with an area at ordinary stages of 120,000 acres, forms a natural reservoir for the regulation of the flow of the river and has always been considered in these studies for additional storage. A natural dam site a few miles below the outlet (see Fig. 2) provides the necessary facility for raising the level of the lake to almost any desired height; but unfortunately the height of the lake level, and consequently the amount of storage that it is now possible to obtain economically, is limited by the area of land that can be overflowed in the vicinity of Kalispell, a town with a population of over 5,000 people situated near the upper end of the lake at an elevation not much above the present high water level. The Columbia River Board, in its studies of storage on the headwaters of the river, recognized this restrictive feature and decided that a fluctuation in level of 13 ft. giving an assumed capacity of 1,600,000 acre-ft. was all that could be provided without excessive property damages.

The effect of differences in storage on the flow of Flathead River at the mouth of the lake is shown by the accompanying table. The storage of 1,600,000 acre-ft., the assumed capacity of Flathead Lake reservoir, increases the low-water flow of Flathead River below Flathead Lake to a minimum in 14 years of 5,460 sec.-ft. and to an average yearly minimum of 7,580 sec.-ft.; the storage of 1,200,000 acre-ft. additional will increase the minimum flow to 7,680 sec.-ft. and the average minimum to 9,860 sec.-ft. The effect of the storage of 2,000,000 acre-ft. and 2,500,000 acre-ft. in addition to that in Flathead Lake is also shown in the table.

Additional storage of 1,200,000 acre-ft. would increase the low-water flow on the average by 2,280 sec.-ft. With a head of 1,000 ft. this would increase the electrical power at 70 per cent efficiency by 182,000 hp. in addition to the power obtained at the reservoir outlet.

Additional storage up to 2,500,000 acre-ft. can be obtained in the proposed Hungry Horse reservoir, on South Fork of Flathead River. A good location for a dam has been found on South Fork of Flathead River, 5 miles above its mouth (Fig. 1). The Great Northern Ry. extends along Flathead River at the mouth of South Fork, and a short construction line could be built from it to the dam site.

At the point selected for a dam site the rock forma-

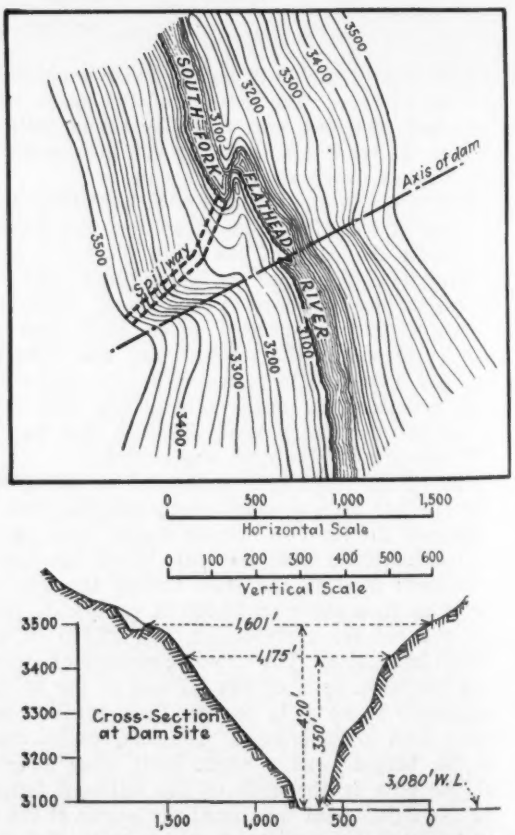


FIG. 3—PLAN AND CROSS-SECTION AT SITE OF RESERVOIR DAM

tion strikes to the northwest and dips about 30 deg. to the northeast. The river has eroded its way across this formation for about half a mile. Its bed is composed of blocks of a dense, angular rock of varying sizes. The abutments on both sides up as far as they are exposed by soil erosion are massive, thick-bedded rock. After the surface exposures are shot away this should form a safe foundation for the dam.

From a comparison with other like drainage areas the annual flow of South Fork of Flathead River is estimated at 3,000,000 acre-ft., which is so distributed that 1,200,000 acre-ft. of storage will give complete regulation and a continuous flow of 4,140 second-ft. A dam 350 ft. high is proposed, with a drawdown of 200 ft., which will provide 1,200,000 acre-ft. capacity for storage and an average head of 283 ft. for power. The spillway will be a short open cut in the rock around the west end of the dam. With a head of 283 ft. and a flow of 4,140 sec.-ft. at 70 per cent efficiency the project should provide 94,000 continuous hp. To this should be added the additional 182,000 hp. made available at sites on Flathead River and Clark Fork, giving (at an assumed efficiency of 70 per cent) a total of 276,000 hp. This storage might also be of some benefit to the proposed Columbia Basin irrigation project in Washington. If only the increased power on Flathead River below Flathead Lake and at the developed site on Clark Fork at Thompson Falls and the power available at the reservoir are considered, the additional power obtained by a reservoir on South Fork of Flathead River having a capacity of 1,200,000 acre-ft. would be 158,000 hp.

The estimated cubical contents of a dam at this site having a maximum height of 350 ft. is 700,000 cu.yd., and at $10 per cu.yd. the dam would cost $7,000,000. If all the power on Flathead River and Clark Fork below the mouth of Flathead River were developed the cost of storage would amount to $25 per horsepower; if only the increased power on Flathead River below the lake and at the developed site at Thompson Falls on Clark Fork and the power available at the reservoir are considered, the cost of storage would be $44 per horsepower. If the power available at the reservoir only is considered, the cost of storage would be $75 per horsepower.

Practically all of the reservoir site is on government land, so the cost of the development of the reservoir would be simply the cost of the dam and spillway, and through the operation of the federal waterpower act practically all projects which would be benefited could be assessed their proportionate share of the cost. All the projects except the one at Thompson Falls, which is already constructed, would come under the Federal Power Commission, and their licenses would provide for payment of proportionate shares of the cost of the headwater storage.

This project is not so economical as the one at the outlet of Flathead Lake, and the projects below the

FIG. 2—FLATHEAD RIVER BELOW FLATHEAD LAKE
Town of Polson on the shore of Flathead Lake

EFFECT OF STORAGE ON FLOW OF FLATHEAD RIVER

Continuous Flow in Second-Feet of Flathead River below Flathead Lake, Montana, with different amounts of storage.

	Flathead Lake	Flathead Lake plus reservoir on South Fork of Flathead River (Hungry Horse Reservoir) for different heights of dams					
		Dam 350 feet		Dam 400 feet		Dam 420 feet	
Capacity in acre-feet	1,600,000	2,800,000		3,600,000		4,100,000	
Year	Sec.-ft.	Sec.-ft.	Diff.	Sec.-ft.	Diff.	Sec.-ft.	Diff.
1909	7,540	10,210	2,670	12,100	1,890	12,100	0
1910	7,880	10,400	2,520	11,650	1,250	11,650	0
1911	8,110	10,360	2,250	11,350	990	11,350	0
1912	7,400	9,800	2,400	10,760	960	11,150	390
1913	8,150	10,900	2,750	10,760	—140	11,150	390
1914	7,490	9,410	1,920	9,810	400	10,050	240
1915	8,440	9,390	950	9,810	420	10,050	240
1916	8,020	9,390	1,370	9,810	420	10,050	240
1917	7,380	10,360	2,980	12,100	1,740	13,150	1,050
1918	8,290	10,600	2,310	12,300	1,700	12,300	0
1919	6,360	8,780	2,420	9,000	220	9,440	440
1920	5,460	7,680	2,220	9,000	1,320	9,440	440
1921	8,660	11,400	2,740	13,300	1,900	12,700	—600
1922	6,960	9,410	2,450	10,930	1,520	10,930	0
Totals	106,140	138,090	.....	152,680	..	155,510	....
Means	7,580	9,860	2,280	10,900	1,040	11,100	200
Minimum	5,460	7,680	2,220	9,000	1,320	9,440	440
2nd lowest year	6,360	8,780	2,420	9,000	220	9,440	440
3rd lowest year	6,960	9,390	2,430	9,810	420	10,050	240

lake will probably be developed first; but after they are developed 158,000 hp. additional can be obtained on Flathead River and at Thompson Falls by building the reservoir on South Fork of Flathead River. Even when considered without regard to benefits below, if a market were available, the cost of development of Hungry Horse reservoir would be low enough to justify the project.

Storage in Hungry Horse reservoir up to 1,200,000 acre-ft. has been considered because this storage would

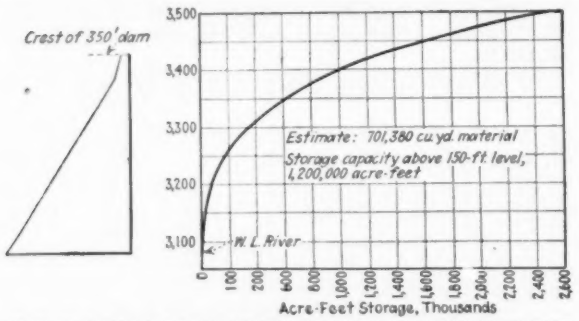


FIG. 4—RESERVOIR CAPACITY CURVE—HUNGRY HORSE RESERVOIR, SOUTH FORK, FLATHEAD RIVER

give complete regulation of South Fork of Flathead River itself, according to very rough estimates of stream flow. Additional storage would increase the power available on Flathead River, and increasing the head would increase somewhat the power available at the reservoir. Therefore storage in Hungry Horse reservoir in excess of 1,200,000 acre-ft. might be justified. It is certain, however, that storage sufficient to equalize the flow of South Fork of Flathead River is economically feasible whenever a market is available and that the construction of this reservoir will add 276,000 hp. to the power resources of Flathead River and Clark Fork and will to some extent increase the low-water flow on Columbia River.

St. Louis Lawyers and Property Owners Warned

Solicitation by lawyers to induce property owners to attempt to collect large damages in street widening cases in St. Louis was so pernicious that in the case of widening Morgan St. to make it an 80-ft. thoroughfare between Third St. and Grand Boulevard the Board of Aldermen repealed the ordinance for the widening. Later on, proceedings were reinstituted on a petition of 60 per cent of the abutting property owners, but with a slight change which carries the widening process a block farther at one end in the shape of a "Y." Subsequently the Board of Estimate and Apportionment made a declaration through the public press of its intention to abandon the widening of Franklin Ave. between Third and Ninth Sts. if the property owners insisted "on attempting to mulct the city by capitalizing the obvious need of wider thoroughfares," *Engineering News-Record* is informed by W. C. Bernard, technical advisor, condemnation proceedings of the law department of St. Louis. Mr. Bernard states: "Here again the property owners were solicited, the solicitation coming after the expiration of the time allowed for filing exceptions to the commissioner's report. As a matter of self-protection, the city is bent on breaking up these pernicious practices of mercenary solicitation and vicious capitalization of a public need."

Highway Transport Survey Begun in Pennsylvania

Study Similar to Connecticut Survey Is Now Under Way—State Highway Department and Federal Bureau Co-operate

Extract from a statement by the Bureau of Public Roads. Results of the Connecticut Survey were published in "Engineering News-Record," issue of March 27, 1924, p. 526.—EDITOR.

IT IS a fundamental principle of economic highway design that no road should be improved to a degree in excess of its earning capacity. Where an effort is made to conform to this principle, the first question asked by the designing engineer is: What will be the volume of traffic when the road is improved? A mere census of the traffic before the road is improved will not answer this question. Is it possible by consideration of the density of the population on the territory adjacent to the road, combined with a study of the volume and character of the production of the territory, its wealth and the number of motor vehicles owned in the tributary area, to develop a basis for such a forecast? This is one of the subjects which will receive the attention of the co-operating agencies in the Pennsylvania survey. Other practical facts sought in the survey are:

The maximum loading and maximum size of vehicles and the frequency of critical loads as an index of pavement width and design requirements.

The effect of congestion at intersections and "bottle necks" upon the rate of traffic flow.

The extent to which the improvement of old roads or the opening of new traffic routes is economically justified.

The type and volume of traffic using the various highways of the state as an index to the allocation of highway construction and maintenance funds.

The relation between traffic loads and density and the costs of highway construction and maintenance.

The amount and frequency of motor truck overloading, the distribution of load to the front and rear axles of the vehicles, the depth and width of tires.

The cost of various types of improvements, such as relocations, grade reductions, elimination of grade crossings and elimination of traffic "bottle necks" with the estimated saving in transportation costs resulting from such improvements.

The earning value of the state highway system in comparison with the present worth of the system using the replacement value minus depreciation as the basis of computing present worth.

The classification of Pennsylvania highways as industrial, high,- medium- or low-type traffic routes based on (1) total passenger car and motor truck density and (2) motor truck capacities. Design is influenced by present and anticipated capacity usage. Routes having a large proportion of trucks of small capacity using the highway will not require the same construction as where heavy capacities prevail.

Basic Economic Data Sought—Besides these facts, each of which has immediate value in connection with the design and administration of the state highways, it is hoped to develop a large number of basic economic data, such as the tonnage shipped by motor truck, marketing methods, and the relation of highway transportation to other methods of transportation. Other information of this character sought by the survey includes the following:

1. The mileage zones of motor-truck haulage and the relation of the type of commodity hauled to such zones.

2. The net tonnage of freight transported by regular and irregular trucking operators.

3. The situs of ownership of passenger cars and motor trucks operating over the state highway system.

4. The value of the net tonnage hauled over the system by motor truck.

5. The origin and destination of the commodities transported over the highway system and the character of origin

and destination: i.e., whether the movement is between farm and railroad, from farm to city merchant, etc.

6. The relation of motor-truck transportation to other methods of transportation, particularly as to competition, rates, operating schedules, and delivery time in the short, middle-distance, and long-haul zones.

7. The data concerning haulage practices of truck operators and the tonnage transportated by motor truck between various cities and areas which are of value to governmental agencies charged with the regulation and control of highway transportation.

8. The usage of passenger cars for business and non-business purposes.

In order to secure the desired information, four divisions have been formed with headquarters in Philadelphia, Wilkes-Barre, Franklin, and Pittsburgh. The operating personnel in each of these divisions is headed by a division supervisor, who reports directly to the field manager or his assistant at Harrisburg. All costs of the survey are shared equally by the Pennsylvania department and the federal bureau.

Traffic Observed at 312 *Stations*—Altogether 312 observation stations have been established, 85 per cent of them on primary roads and 15 per cent on secondary roads. At 78 of these stations the information secured includes complete weight data; the others, known as recording stations, have no weighing facilities. Pit scales have been installed at 18 of the most important weighing stations. The other 60 are equipped with portable Berry scales.

In each division the personnel is divided into parties, which, according to the stations to which they are regularly assigned, are known as pit scale parties, Berry scale parties, recording, and night parties. Thus, in the Philadelphia division, there are 2 pit scale parties, 1 Berry scale party, 3 recording parties, and 1 night party. In the Wilkes-Barre and Franklin divisions there are 2 recording parties, 1 Berry scale party and 1 night party; and in the Pittsburgh division there are 2 Berry scale parties, 2 recording parties, 1 pit scale party, and 1 night party.

Each recording party has 26 stations at which it operates each month, working every day at a different station. A pit scale party remains at each station a week and completes its cycle in 6 weeks, there being 18 stations and 3 parties. Each Berry scale party operates 12 stations, and by remaining at each station 2 days completes its cycle in about a month.

In addition to these parties, which are occupied mainly in collecting the motor-truck data, a single passenger-car party moves from station to station and division to division to obtain the prescribed information with reference to passenger-car traffic; and the night party in each division, operating at key stations on selected routes, secures the information with regard to the night traffic which will be used to extend the traffic observations to a twenty-four-hour basis.

The arrangement of the stations is such that the weight data secured at the 78 weighing stations can be applied to the traffic observed at the 234 recording stations, and the schedules of the various parties are so devised that there is no duplication of the records.

The observations of the night parties are especially important in the Philadelphia division because of the heavy night movement of trucks between Philadelphia and New York. Sixty per cent of the movement between these cities takes place at night, much of it in convoys under the charge of a truck master. As many as nine trucks have been counted in these highway freight trains.

Several items of information are being obtained in this survey which have not been secured in any previous survey. For example, the information in regard to origin and destination of truck shipments embraces not only the terminal points but the character of these points, so that it will be possible to describe the exact character of each movement as a farm-to-railroad shipment, residence-to-residence, manufacturer-to-jobber, etc. The observations with respect to the situs of motor-vehicle ownership also constitute a new class of information; and the passenger bus data, including origin, destination, capacity, number of passengers and frequency of trips will be more complete than any similar information previously secured.

Flood Control Project for Lower Rio Grande

A FLOOD control system to protect a half million acres of land in the Rio Grande Valley is proposed by Hidalgo, Cameron and Willacy Counties, Texas. Under the project, floods would be prevented by means of a long floodway channel, with two short inlets at the westerly end and two long forks at the easterly end. Tentative estimates of the project put the cost at $3,000,000, excluding the right-of-way. Hidalgo County has recently voted $1,600,000 toward the cost of the project. It has apparently been encouraged to do this by the passage of a bill through the Texas Legislature remitting state taxes in that county for a period of twenty-five years in case the project is put through. It is expected that the other two counties will secure similar tax remission and vote bonds for the project.

The floodway would have a width of a half mile to a mile and a capacity of 120,000 sec.-ft. The river and natural relief channels at its lower end has a capacity of 50,000 sec.-ft. The estimated maximum flood flow of the river is 160,000 to 170,000 sec.-ft.

The floodway is designed to protect "first lift" lands which are becoming increasingly subject to overflow. A large part of the north bank of the floodway would be formed by the use of land between the "first lift" and "second lift" land.

According to a description of the project by Harry L. Sexton in the *Rio Grande Valley Weekly* (San Antonio, Texas) of June 28, preliminary plans for the Hidalgo County section of the floodway were made some years ago by Charles P. Williams, an engineer of the United States Reclamation Service, acting with W. F. Shaw, chief engineer of the Mercedes irrigation system in Hidalgo Co. *Engineering News-Record* is informed by W. F. Heath, chief engineer, Cameron County Water Improvement District Number Two, San Benito, Texas, that W. E. Anderson, president of the Valley Association of Engineers, has been employed by the six irrigation districts of Cameron County to co-operate with Mr. Shaw, the latter representing Hidalgo County, Mr. Williams of the Reclamation Bureau and Harry A. Stiles, head of the Texas Reclamation Department, in the preparation of a co-ordinated flood control for the three counties.

Canal Bed for Motor Freight Road

A bill has been presented in the British House of Parliament proposing to drain Regent's Canal in London and to convert the bed into a sunken road for motor freight traffic. The canal, completed in 1820, extends from the Thames at Limehouse Basin to the Grand Junction Canal at Paddington, and before the advent of railways and motor trucks carried an enormous tonnage. The Thames end is in the center of the dock system on the north side of the river and is within 500 yd. of the Rotherhithe vehicular tunnel, which crosses under the river to the great Surrey commercial docks on the south side. The canal passes near all the great railway freight terminals north of the Thames, except the Liverpool St. station of the present London & Northeastern Ry. It is 8½ miles long, 60 ft. wide, and 12 ft. deep. The plan is to revet the sides, pave the bottom, and have two 20-ft. roadways through the center for traffic and a 10-ft. space on each side for loading and discharging vehicles. Water, electricity, and sewage will be carried below the roadway.

American Water-Works Practice: Observations of an Australian

Being the Impressions of E. G. Ritchie, Engineer of Water Supply, Melbourne and Metropolitan Board of Works

AFTER a visit of about three months in America, in pursuit of inquiries into up-to-date practice in water-supply engineering and sewage treatment, I am about to proceed to Great Britain and Europe to extend these inquiries further. I have profited very much from the opportunity of visiting works and discussing problems with American engineers which my visit has afforded. I feel satisfied that the sending abroad of officers experienced in the knowledge of what is valuable for their own circumstances and conditions is a very wise policy for any public body to follow. The outstanding feature of my experience in America is the very great kindness and courtesy which has everywhere been extended to me by the various engineers I have met. I shall carry away with me vivid recollections of the accessibility of American engineers, their readiness to discuss, to impart and to assist their professional brethren in every way.

Engineering Co-operation—The experience of getting together and talking things over which is practised by American engineers in their own inter-relationships is one of the factors in the great progress of engineering knowledge in America. I hope that this exchange of experiences will be further extended and that American engineers will come to Australia more than they have done in the past. The country is nearly as large as the United States and there is much which would interest American engineers. The outlook of the Australian engineer is very similar to that of the American engineer.

I am not in a position to make any summary of my observations at the present moment so far as their value will be in dealing with Australian problems. It will take a little time to digest all that I have seen and learned and in due course I shall report to my Board. There are very great differences in climate, which account for some of the differences in practice which I have observed, and what is good practice in America is by no means necessarily so in Australia and vice versa. If there is one thing which strikes me, it is the value of actually visiting the country where it is desired to obtain engineering information. If reliance is placed entirely upon recorded information, even that available in the best engineering literature, very erroneous conclusions may be drawn.

One of the most notable of my observations has been the extent to which machinery is being employed on engineering work, particularly on all classes of earth work in America. While this aspect of engineering progress has been by no means neglected in Australia, it can, I am sure, be extended there with very great advantage in view of the high costs of labor which are now ruling and which are appreciably approaching the costs of labor in America. My visit to America will be very profitable in the wider knowledge I have obtained of up-to-date American appliances and the conditions which govern their successful use in this country.

I have been particularly struck by the progress which is being made in earth dam construction. Some of the structures I have seen in America give evidence of a great advance by American engineers in the employment of this class of structure. Much greater confidence is being displayed everywhere in the use and in the greater heights of earth dams and it is becoming more and more realized that in the right situation, with sufficient safeguards, an earth dam properly constructed is just as good and just as permanent as a masonry or concrete structure, and possibly even more so.

I found it of great advantage to be able to attend the convention of the American Water Works Association held in New York. The wide opportunity which such an association affords to engineers and the manufacturers of water-supply material and equipment to get together was presented to me in the recent convention and I feel that Australian engineers and manufacturers have much to learn in this respect.

While Australian engineers have a great deal to learn from their professional brethren in America, they are not so much, if at all, behind them in some matters.

Water-Supply Pipe and Use of Water—In regard to practice in the use of steel pipe Australian engineers are, in my opinion, well in the front line. It is perhaps not surprising that Australia should be up with America in this respect in view of the low costs of cast-iron pipe in America in the past. The higher costs of cast-iron pipe now prevailing, however, have given a greater impetus to the use of steel pipe than has prevailed in the past. I feel sure that those American engineers who have hitherto been mainly using cast-iron pipe and are now engaged upon introducing the use of steel pipe will find that unless there is something very unsuitable in condition of soil and water this material, in the larger sizes of pipe, will be found just as suitable and just as serviceable as cast iron, particularly if greater advance is made in the use of more permanent coatings for pipes than have been adopted in the past. In Australia, we are very ready to use all classes of materials for our pipe, such as cast-iron, steel, concrete and wood, for we recognize that if we had been limited to only one or two of these materials the development of our country would have been greatly retarded.

I have been particularly struck in my observations and inquiries with the lavish, if not wasteful, use of water in America. In a climate such as Australia water is very freely used both for domestic and manufacturing purposes and very largely for gardens, and though I consider our people have been very abundantly served in this respect it is surprising to find that in most American cities the consumption of water is nearly double that in Australia, in some cases much higher still. There may be many reasons to account for this but I cannot help wondering whether the outlook of the ordinary American consumer has been formed in view of the abundant supplies available in the past. Though Australia is not nearly such a badly watered country as is commonly supposed, I think the Australian outlook has been of a more provident nature than that of the average American. Conservation works have been actively prosecuted but these have not so far resulted in the formation of more wasteful habits and I do think that there is room for a good deal of improvement in the future in this respect by the ordinary American consumer of water and that with the requirements of increasing population this consideration will be forced upon him more strongly than it has been in the past.

Alum Agitation Studies at Reading, Pennsylvania

Importance of Thorough Mixing in the Coagulation of Turbid Waters with Alum Shown—Fifteen Minutes at a Little Over 0.5 Ft. per Second Meets Reading Conditions

By Charles R. Cox
Chief Chemist, Bureau of Water, Reading, Pa.

AN EXTENSIVE literature on the coagulation of turbid waters is available to workers in this field, but little attention has been paid to the question of mixing the alum solution with the waters to be coagulated. In numerous mechanical filtration plants reliance is placed on the limited mixing obtained in passing the alum-treated raw water through centrifugal pumps to the coagulating basins, while, on the other hand, elaborate baffled basins are provided at other plants to agitate the treated water thoroughly before sedimentation. This wide variation in the degree of mixing provided does not seem to be correlated with variations in raw-water quality, or any other characteristic, but seems to be due rather to fundamental differences of opinion among designing engineers. One school of thought favors violent but limited physical mixing to cause rapid diffusion of the added chemical, to be followed by quiescent storage to allow for chemical reaction and sedimentation. The other school favors the continuation of mixing after the initial diffusion has occurred to provide contact between the forming aluminum hydoxide flakes and the clay and bacteria in colloidal suspension. The following data were obtained to ascertain which of the above two views suited local conditions best in Reading, and to determine what influence mixing had upon the efficiency of subsequent sedimentation.

The data indicate clearly that the latter view, advocating continued moderate mixing for considerable periods, applies to Reading water. They show that mixing serves a dual purpose, that of aiding diffusion of the added chemical, and facilitating the intimate contact between the floc and the suspended matter of the water. Diffusion is very rapid in any case, so the chief value of thorough mixing is to aid the physico-chemical mechanism of coagulation by agitation. This agitation may be so slight as to be ineffective, or so violent that the forming floc is disrupted and kept small. The period of mixing is governed by the time required for the physico-chemical reactions to occur and by the structural limitations as to the size of the mixing unit. Fifteen minutes mixing at a little over 0.5 ft. per second average velocity meets these criteria for Reading conditions.

Experimental Work—The successful experiments carried out in Sacramento (*Engineering News-Record*, June 2, 1921, p. 924) with small, mechanically-operated paddles in circular vessels led to the adoption of the same type of apparatus in Reading. A brass paddle 1½ in. high by 4½ in. wide was attached at the center to a vertical shaft in such a position that it could be revolved inside a two-liter beaker, about 1 in. from the bottom (Fig. 1). The ends of the paddle came within ⅛ in. of the side walls of the beaker. The following paddle speeds were obtained by varying the resistances in series with a small motor used to drive the vertical shaft, namely, 12, 18, 28, 33, 40, 56 and 80 r.p.m. The paddle was large enough to cause a liter sample of water to revolve at nearly its speed, but the friction against the beaker walls was sufficient to create a drag, and eddies resulted throughout the whole body of water.

Various liter portions of the water under observation were dosed with different quantities of alum and mixed at various rates until the character of the floc indicated complete coagulation. In this way data were obtained upon the alum doses required for various turbidities, and the periods and degree of mixing necessary for each alum dose.

The hardness, alkalinity, carbon dioxide content, hydrogen-ion concentration, turbidity and coefficient of fineness for each water were ascertained, as well as the final hydrogen-ion concentration after the addition of

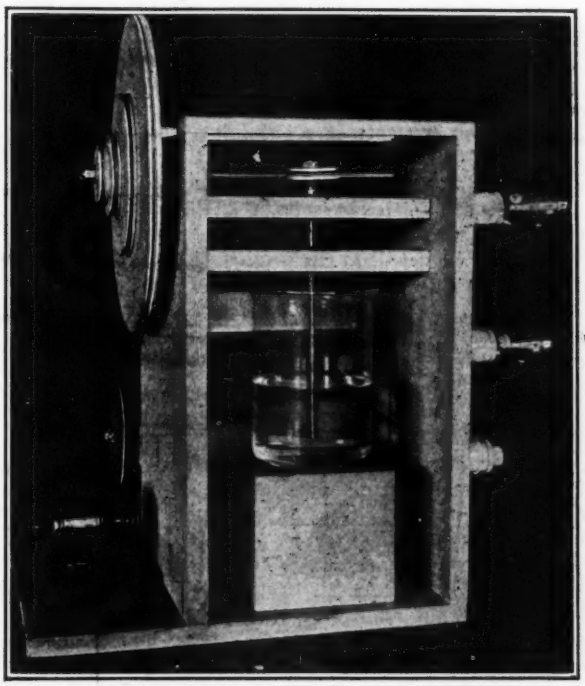


FIG. 1—COAGULANT AGITATOR USED AT READING

each dose of alum. These data are illustrated by the table on p. 104, where typical results for turbid waters are given. The last column gives the average of the monthly determinations in 1923, which are quite different from the turbid waters used in the experiments, due to very low average turbidity and relatively higher mineral content during the periods of low stream flow.

The final alum doses selected for each water are plotted in Fig. 2. It will be seen that the amount of alum needed under the conditions of the experiments is slightly less than that represented by "Stein's medium curve," also plotted in Fig. 2. It was soon seen that additional mixing permitted a reduction in the alum dose for certain typical waters. Fig. 3 shows that considerable alum may be saved by utilizing the longer periods of mix, but there is a minimum alum dose for each water, below which coagulation will not occur, irrespective of velocity and period of mix. This seems to be due in

part to the adsorption of part of the alum by the clay in suspension, thus removing it from the sphere of action, and also to the failure to produce the required physico-chemical conditions for coagulation. However, the important point is that there is a critical minimum dose of alum for each water, and this cannot be changed by varying the mixing conditions. This fact has been utilized in selecting the final alum dose for each specimen of water. A mixing period of fifteen minutes, at an average velocity of 0.4 ft. per second, was used, and the alum increased by small increments until satisfactory coagulation occurred. This results in the selection of alum doses well above the critical minima already mentioned, and provides a factor of safety for practical operating conditions.

Observations were made of the hydrogen-ion concentrations obtaining when coagulation occurred with these selected alum doses, but the results are not very consistent, and point to a major influence of other factors. The concentrations all fall within a limited zone, however, centering on the acid side of neutrality, or pH 7, as evidenced by the few results shown in the table. This is not in agreement with considerable evidence from other sources that coagulation with alum occurs best at the hydrogen-ion concentration obtaining at the isoelectric point of aluminum hydroxide, or pH 5.5. There are numerous data, however, which indicate that, with hard waters containing buffer salts, coagulation occurs when the prevailing pH values are near 6.8, or in the range found to be favorable in our limited work on the subject.

It appeared unnecessary, therefore, to complicate chemical dosing by providing for acid treatment to adjust the hydrogen-ion concentration of the water, attention being placed upon the question of mixing and associated factors. Experiments are planned for the future, however, when the subject of economy in alum dosing will be investigated for the water in question.

The lengths of mixing period needed for various intensities of mix are shown in Fig. 4, where the alum dose as previously selected was held constant for each water. As might be expected, the data do not fall along a single curve, but are grouped in a bank defined by the two dotted lines. As all of the periods of mix are longer than that required for physical diffusion of the alum, it follows that mixing must have a secondary effect beyond that accomplished in simple mixing of the alum and the water. A consideration of the physico-chemical process of the precipitation of suspensoids will indicate why this is so.

Physico-Chemical Considerations—The reaction between aluminum sulphate and the natural, or added, alkalinity of the water produces aluminum hydroxide under favorable conditions. The speed of this reaction depends upon concentration, temperature, the degree of solution or ionization of the reacting agents, and the facilities for contact between these agents. Concentration is controllable to some extent through adjusting the alum dose, and contact is provided by thorough mixing; otherwise the reaction is beyond the economic control of the operator. The insoluble aluminum hydroxide is precipitated in the form of minute aggregates, which normally have a positive electrical charge. The extent of this precipitation, per unit of reacting material, depends upon the hydrogen-ion concentration of the treated water and this in turn depends upon the alum dose, the alkalinity, the carbon dioxide content, and the quantity of buffer salts present in the water. The control of the hydrogen-ion concentration through the use of acids is foreign to this discussion, but granting the initial conditions favoring the precipitation of the maximum amount of aluminum hydroxide, it is seen that agitation will greatly aid the formation of flakes of the precipitate by bringing the individual particles into contact with each other, thus favoring simple accretion. On the other hand, too violent agitation will defeat this process by breaking the larger floc into smaller units.

The agitation of the positively charged floc brings the negatively charged bacteria and clay colloids within the sphere of its electrical attraction, and adsorption occurs on the surface of the floc. The process may be likened to filtration in which the filtering material passes through the water rather than the reverse. Complete adsorption will occur, provided the positively charged floc is in excess of the negatively charged clay and bacteria and all the material to be adsorbed is brought into due contact with the floc. This provision involves the two fundamentals of alum dose and degree of agitation. It may be seen that a certain "quantity" of agitation is required, which may be analyzed into time and intensity factors, roughly inversely proportional to each other. This is shown in a practical way in Fig. 4, where the decrease in the necessary "time" of mix is shown to follow increases in the "intensity" of agitation. It follows from the above that thorough mixing can be utilized by the operator to overcome partly slow, or poor, coagulation occasioned by low temperature, and the presence of stabilizing, protective, organic colloids, provided the alum dose is adequate, and the physico-chemical complex is favorable to the production of the maximum amount of insoluble aluminum hydroxide.

Mixing—It would appear, therefore, that prolonged agitation, or mixing, is justified and beneficial, but we are still concerned with what are the practical limits for such a process. Inspection of Fig. 4 will indicate that, under the conditions of the experiment, satisfactory coagulation occurred between the limits of 20-min. mix at 0.25 ft. per second average velocity and 8-min. mix at 0.80 ft. per second average velocity. The lower velocity is just sufficient to keep the partly formed floc in suspension. The floc is large and feathery and easily broken, but coagulation is complete, and the water would be in condition to be turned into a sedimentation basin, provided the entrance velocities were not high enough to break the floc by excessive agitation. It would be impractical to use such a slow velocity, however, in the design of a flowing-through mixing basin, because of excessive size of the structure, and the inability to operate at less than the designed rate of flow.

The higher velocity produces a small, firm floc, easily handled, and having rapid settling ability, which seems to be due to greater density. This characteristic is important in that such a floc is not thrown into suspension after settling as readily as lighter and more feathery material. Excessive velocities are not desirable, however, due to the considerable loss of head they involve, and the danger of the size of the floc being kept too small by the violent agitation. In addition, the rate of flow could not be increased much beyond the designed rate without introducing conditions unfavorable to economical mixing through serious loss of head, excessive agitation and short mixing period. It appears

that this period should not be much less than about 8 min., irrespective of what velocity is used, otherwise there are likely to be occasions when the time available for mixing is not sufficient to permit the physico-chemical reaction of coagulation to be completed. It seems safe, therefore, to conclude that the selection of a medium velocity of mix and length of period will result in a greater available range of velocities on either side of the designed rate, a limited loss of head in the mixing basin, the production of a firm and not too small floc, the provision of ample time for delayed physico-chemical reactions, and the use of a mixing basin of practicable size. Our data show that a period of 15 min. at the average velocity of 0.5 ft. per second would meet these requirements. Extending the period, or increasing the velocity somewhat, would provide a factor of safety for those occasions when the alum dose is slightly under that desirable, the temperature low, or the water hard to coagulate, because of the presence of organic matter.

It was thought that an excellent floc could be formed if the degree of agitation were varied during the mixing period to suit the requirements of the various intervals in the period. A relatively high rate of mix at the start would aid diffusion and colloidal coalescence, and this rate could be reduced as the floc grew in size to avoid rupturing the flakes. Numerous mixing schemes of this nature were tried out, and the results, not included in our data, indicate a slight advantage over a constant-rate mixing scheme utilizing the same loss of head. It was soon realized, however, that any mixing scheme, involving widely differing rates of flow, would limit the flexibility of the apparatus, because the range in rates inherent in the scheme would be a considerable part of the economic possible range, leaving little leeway for variations in flow. Such schemes were abandoned, therefore, in favor of one involving a constant degree of agitation for any one rate of flow.

The experiments at Sacramento with small laboratory and large field apparatus indicate a close agreement in effective velocities and periods of mix when using the two sizes of apparatus. We might assume, therefore, that the conclusions reached with our mechanical mixing device may be applied to large-size mixing basins. It may not be out of place here to suggest that a similar device be used in the routine control of coagulation rather than the well-known jar tests, where mixing by shaking is hard to control and standardize and where the method is entirely unlike mixing in baffled basins. A small-scale laboratory device could be easily correlated with results actually obtained in the plant with the same water, and, thereafter, the small mixer could be used to control chemical dosing very accurately.

Sedimentation—It has been assumed that, with complete coagulation occurring in the mixing device, the coagulation basin would be used for sedimentation only, and not to furnish opportunity for delayed coagulation. This scheme has a number of advantages over that where mixing is given secondary importance and reliance is placed upon large coagulating basins. In the first place the success of any selected alum dose in coagulating a particular water may be ascertained at the end of the mixing period, in 15 to 20 min., and any correction may be applied at once, thus preventing the filling of the coagulating basin with improperly dosed water. Secondly, a poorly mixed water, even though properly dosed with alum, coagulates slowly in the quiescent condition in a coagulating basin, and the floc finally formed is very fine and settles slowly, requiring a relatively long period in the basin. Thirdly, the fine floc formed during quiescent flow through a basin is so fine that any short-circuiting, due to poor baffling, wind action, or temperature stratification, has a more marked effect in keeping the material in suspension. These facts may point to one reason why large coagulating basins are needed at so many plants, where mixing may be poor and the first part of the sedimentation period is required to complete the coagulating reaction. Greater economy in structure cost would result if larger mixing basins and much smaller sedimentation basins were used.

Experiments carried on at Sacramento (based on

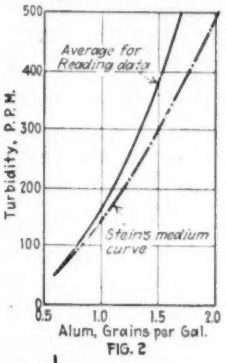


FIG. 2

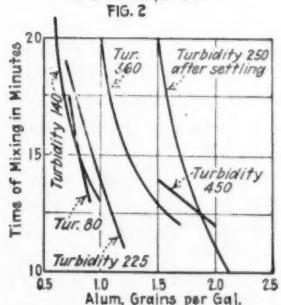


Fig. 3

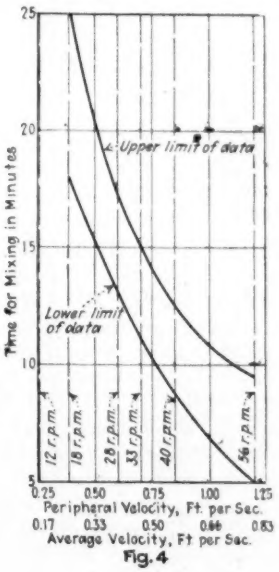


Fig. 4

FIG. 2—ALUM DOSE NECESSARY TO COAGULATE MAIDEN CREEK WATER OF VARYING TURBIDITIES

FIG. 3—REDUCTION IN ALUM DOSE MADE POSSIBLE BY INCREASING MIXING PERIOD

FIG. 4—RELATION OF TIME TO INTENSITY OF MIX OR VELOCITY OF FLOW

personal communication from Harry N. Jenks, sanitary engineer, Filtration Division, Sacramento Water-Works) and elsewhere indicate that the rate of sedimentation of properly coagulated water is rapid, even at fairly high rates of flow. These results have been substantiated by our work where the coagulated waters were allowed to settle in the two-liter beakers. The majority of the floc settled in the first 5 min., and most of the remaining floc in 30 min. The waters were usually clear in two hours, a point desirable in preliminary treatment before slow sand filtration, but not before mechanical filtration. The same results were experimentally demonstrated by Wolman and Burroughs in May, 1921, in Maryland (data unpublished).

It is realized that sedimentation conditions in beakers are quite different from those in large flowing-through basins but nevertheless the major factors are the same. The water in beakers is not subjected to the eddies resulting from short-circuiting or wind action but, on the other hand, the small-scale conditions lack the beneficial effect of mass action of large quantities of coarse

floc falling from higher levels and carrying the finer material with it.

General conclusions may be formed, therefore, regarding the design of large sedimentation basins, provided due allowance is made for certain factors inherent in such basins. These are: (a) The entrance velocity into the basin should be relatively low to prevent destruction of the floc and the setting up of swift surface currents. (b) Baffling should be provided to prevent short-circuiting due to entrance velocity, or temperature stratification. (c) The ratio of surface area to depth of basin must be so adjusted that the horizontal path of flow is kept long in proportion to the vertical path of sedimentation. (d) Due provision must be made for sediment, or sludge storage space, so that the basin will not have to be thrown out of service at frequent intervals to prevent the scouring action of the flow on the settled solids. (e) The period of sedimentation should be adjusted to provide additional time or capacity to care for unexpected overloads, or slow sedimentation from one cause or another.

CHEMICAL ANALYSES OF TYPICAL SAMPLES OF MAIDEN CREEK WATER, READING, PA.

(Results in parts per million unless otherwise noted.)

	Aug. 17*	Sept. 5*	Jan. 23	Mar. 3	Mar. 5	Mar. 12	Mar. 14	Apr. 6	Monthly May 9	Monthly Av. 1923
Total hardness	94	91	50	50	46	44	54	42	....	82
Alkalinity	72	68	35	38	46	44	54	38	44	73
Carbon dioxide	3.5	6.6	2.6	6.0	0.0	1.8	2.6	2.8	5.7	5.3
Hydrogen-ion concentration pH scale	....	7.2	7.1	7.0	7.8	7.0	6.9	7.4	8.0	7.2
Coefficient of fineness	0.31	0.26	0.62	0.97	0.55	0.78	0.89	0.52	0.46	....
Turbidity	330	185	50	225	140	360	80	450	250	21
Best alum dose, grains per gal.	....	....	0.75	0.8	0.7	1.3	0.7	1.5	1.75	....
pH value after alum was added	....	....	6.7	6.9	7.1	6.8	6.8	7.3	6.6	....

* Aug. 17 and Sept. 5 results for year 1922; others for year 1923

Bearing these factors in mind, it is thought that a theoretical sedimentation period of four hours would be ample to care for the preliminary treatment before slow sand filtration. Longer periods than this would provide only for the additional sedimentation of a small amount of very fine material, and the added expense would not be justified. The period might be reduced well below this figure when the basin is to precede mechanical filtration, where a small amount of floc is needed on the surface of the filters, and, therefore, sedimentation should not be complete. A two-hour period should be ample in this case, and, if conditions permit, a series of sedimentation units, to be used in parallel, might be provided, with the possibility of eliminating part of the equipment when the full capacity is not needed. This would permit using periods, for those rates below the designed capacity, which provide a settled water efficiently filtered by rapid sand filters.

It is realized that the above discussion deals with data collected in mixing and coagulating an individual water, but the fundamental factors considered apply to the coagulation of all turbid and colored waters, although the quantitative data are specific and may not apply universally. Nevertheless, the value of continued agitation for a considerable period is clearly indicated as being perferable to violent mixing for a short period, followed by quiescent coagulation. This would seem to apply with equal or added force in the case of the mixing of waters to which a coagulant and softening chemical have been added, where the physico-chemical reactions are more complex. Data from Columbus and other Ohio cities substantiate this opinion. (Paper read at the 43rd Annual Convention, 1923, A. W. W. A., by C. P. Hoover upon "Mixing Devices and Reaction Time.)

Conclusions—The following conclusions may be drawn from the data presented:

1. Agitating or mixing alum-treated waters before sedimentation is one of the important factors in coagulation under the control of the designer and operator.

2. Agitation causes the rapid diffusion of the added chemical, favors growth by accretion of the aluminum hydroxide floc, and permits intimate contact between this floc and suspended matter, whether clay, bacteria or other material.

3. Agitation may be analyzed into intensity and time factors, which are roughly inversely proportional to each other.

4. The intensity of agitation is limited by the economics of maintaining high velocities and the destruction of the partly formed floc, on the one hand, and by the necessity of exceeding a minimum velocity sufficient to keep the floc in suspension, on the other hand.

5. The maximum period of agitation is limited by the economic size of the mixing unit. Conversely, the minimum period is determined by the time necessary to complete the chemical reaction, to reach physico-chemical equilibrium, to permit accretion of the floc into flakes of good size, and the opportunity for the floc to come in contact with the suspended clay and bacteria.

6. The data indicate that by combining these limits the following range in mixing is possible: 20-min. mix at the average velocity of 0.25 ft. per second and 8-min. mix at 0.8 ft. per second average velocity.

7. Due to the necessity of providing for fluctuations in flow on either side of the designed rate, a medium velocity and period of mix are preferable.

8. Fifteen minutes' mix at 0.5 to 0.6 ft. per second average velocity would be adequate for Reading conditions.

9. Mixing schemes involving decreasing intensity of agitation as the mixing proceeds have certain advantages, but limit the flexibility of the mixing-unit.

10. Coagulation is so slow under the conditions of quiescent sedimentation that no reliance should be placed upon coagulation in settling basins.

11. Complete coagulation in the mixing unit enables one to determine the adequacy of the alum dose at the end of the mixing period, and permits the production of a water easily settled and less subject to the adverse influences of short-circuiting.

12. A theoretical period of sedimentation of four hours is sufficient, when coagulation and sedimentation precede slow sand filtration. This period probably may be reduced to two hours or even less in the case of mechanical filtration.

13. The importance of thorough mixing would seem to apply to the coagulation of colored waters and to water softening to a greater extent than to the coagulation of the average turbid water.

Acknowledgments—The above data were secured in connection with the studies of extensions and improvements to the water supply system of Reading, Pa., being made by Arthur Reeder and George Weighardt, under the direction of Emil Nuebling, chief engineer, Bureau of Water, by the writer, from chemical and biological investigations.

Some Requirements in the Study of Portland Cement

Quest for Better Concrete Must Give Attention to Inherent Characteristics of This Most Important Ingredient

By Thaddeus Merriman
Chief Engineer, Board of Water Supply, City of New York

AMONG the many materials used in the world of engineering construction none is of more importance or of greater utility than portland cement, which has come to be the basis of nearly all concrete made with calcareous binders. Our knowledge regarding the qualities and characteristics of cement, however, is not as far advanced as is that relating to others of the manufactured materials which enter into the numerous structures designed and built under engineering supervision. The reason for this condition is apparently to be found in the extremely complex nature of the material itself. Chemical analysis does not serve to distinguish or identify the nature of the several compounds of which the cement is composed. Microscopic examination has been helpful and has done much toward advancing the sum total of information on this important question. Many physical tests of various kinds have been suggested and countless thousands of briquets and cylinders have been broken but the mystery as to what occurs in the process of "setting" has never been solved. No explanation which fits all of the observed facts relating to this phenomenon has yet been advanced.

The search for a better concrete, as evidenced by most of the recent investigations, seems to have for its object the securing of a more uniform quality with respect to careful selection, proportioning and mixing of the constituents and with the end in view of securing a maximum of strength for a minimum of cost. Strength, apparently, is the only criterion by which quality and durability are judged. But what relation is there as between the strength of concrete at 28 days and its ultimate durability?

Nearly all concrete is good when first placed. In many situations it continues good and is possessed of a high degree of durability and permanence. In other situations, however, disintegration sooner or later begins and progressively continues. In many such cases the principal contributing cause is probably the porous nature of the concrete while in a fair percentage of cases the causes of disintegration are obscure and cannot be ascribed to any particular condition.

A portion, at least, of the troubles which sometimes occur arises from the fact that, quite unconsciously, we have come to consider cement as a universal material suitable for use everywhere and under all conditions. There is only one standard grade of cement but many different qualities of steel are to be had for the asking, and each one of them fills a particular need. So, also, should it be with cement. The general use of one grade of material for all purposes does not tend toward true and ultimate economy.

Cements Not Alike—The art of mixing and proportioning concrete has been advanced to such an extent that it is now possible, by considering the sizes, the relative fineness, and the proportions of the aggregates, and by controlling the mixing water, to "design" a concrete mixture so as to secure, for a given cement content, a maximum of strength and density, as these terms are commonly understood. These studies generally, however, take no account of the differences which exist between different types of cement, and so it happens that results obtained with one type cannot be duplicated when another is used. The assumption tacitly made by many investigators, that all cement which passes the requirements of the standard specification is of equal quality, is untenable. Some types of cement will produce concrete of greater strength than will others. Certain types are less sensitive to an excess of mixing water; others will produce a high early strength; still others will not give a high strength until after the lapse of months. As has long been recognized, the age of the cement is also a vital factor in affecting the activity and integrity of its constituent components. Can it, then, be fairly assumed that all types of cement produce concrete of equal permanence?

The very best mixture of the finest obtainable aggregates is of itself useless as concrete. The material which binds the mass together is the cement and no amount of care in proportioning the sand, the stone and the water and in making the concrete according to current good practice, can overcome a deficiency which may exist in that ingredient. The search for a better and a more uniform concrete, necessary for many purposes, seems to have arrived at the stage which indicates that the next logical step is an examination of the cement itself.

When the field of study and endeavor in matters relating to calcareous cements is reviewed, the one outstanding feature to be observed is that these investigations have proceeded on the principle of direct observation under limited conditions and in restricted combination. Little, if any, effort in reported results has been put forth along the line of indirect and collateral analysis, a method which has proven to be of the greatest use in practically all those lines of scientific endeavor in which great and substantial progress has been recorded. Similar methods of research must be employed on the problem of cement, else the cause of concrete will fail of substantial progress.

Why Not a Neat Tensile Test?—In 1917 the "Standard Specifications and Tests for Portland Cement" of the American Society for Testing Materials were revised and the requirement of a test for the tensile strength of neat cement briquets was eliminated. This test was the only physical test of the cement *per se* which the specifications contained, because the 1:3 mortar test briquet discloses not the strength of the cement but rather its ability to adhere to the grains of the Ottawa sand with which the specimen is made. This statement will become clear if the broken end of any 1:3 briquet is examined and it is seen that about 45 per cent of the area of fracture consists of clear sand grains from which the cement has cleanly parted while another 45 per cent consists of the cavities left by the sand grains of the other half of the briquet. This test, evidently, is a measure of the adhesive quality of the cement and is by no means an index of its inherent tensile strength.

The tensile test of neat cement when mixed to the standard consistency called for by the specifications prior to 1917 was abandoned for a variety of arguments, among which the following may be cited:

1. The test is unnecessary. It discloses nothing which the sand briquet does not show.
2. Tensile tests, at best, are not of great utility.

Compressive tests are of more value. The usual forces which concrete and mortar are called upon to resist are those of compression and shear.

3. The test is not a fair one. As the strength of the specimen increases, it becomes more and more brittle, with the result that the stresses set up by the grips of the testing machine become so complicated as to render the results of doubtful value. Thus, the retrogression in strength from 7 to 28 days often noted is not due to any inherent quality of the cement but is the result of the rigidity incident to increased strength.

4. The results as between the tests on the neat and the sand briquets are often conflicting and not to be reconciled.

It has already been shown that the first of these arguments was far from being sound. As to the second, it only seems necessary to point out that whenever concrete or mortar fails under stress the evidence nearly always indicates a failure in tension or in shear. It seems extremely doubtful that any material can fail under a compressive force unless its tensile and shearing resistances are first overcome. In general, if all other conditions are the same that material which shows the highest tensile strength will develop the greatest resistance to compressive forces. In the case of concrete and mortar, however, it seems as though the reverse were often true. This point will be discussed in detail at a later time.

The third argument, as above stated, while of itself plausible enough, does not seem to be sufficiently convincing by itself to warrant the exclusion of a tensile test on the cement. The fourth argument was based on the facts as observed but not on a true understanding of their meaning because it failed to take account of the essential differences in the fundamental nature of the tests themselves.

The neat test was an index of the quality of the cement when mixed to the standard consistency with about 20 to 25 per cent of water. On the other hand, the sand briquet test was made by mixing three parts by weight of Ottawa sand with one of cement and with an amount of water which averaged from 39 to 43 per cent of the weight of the contained cement. In view of the known effect of water on cement it could not be expected that the results of these two tests would always be concordant. Some types of cement will take care of greater quantities of water than will others —that is to say, all cements do not behave in the same manner when mixed with equal quantities of water. These two tests. moreover, are of a different nature; the cement particles in the neat briquet lie very much closer together than they do in the sand specimens. The first of these tests is a measure of the adherence between the cement particles; the second is an index of cohesion between cement and sand grains.

The foregoing briefly outlines certain fundamental considerations that need to be given extended study in connection with the development of tests which will more truly disclose the quality of cement than do those now available. In setting forth these considerations no criticism of portland cement or of the present specification is intended. The important thing is that our knowledge regarding cement, its qualities and its characteristics, should be broadened to the greatest possible extent. The omission of the neat test has served to focus attention on a phase of the subject which might otherwise have escaped notice for many years and has thus come to serve a most useful purpose.

What Should Be Studied—A complete and comprehensive outline looking toward the determination of quality and the classification of different types of cement will include at least some of the following:

1. Permissible variations in chemical composition and characteristics, with limitations on certain of the ingredients.
2. Requirements as to fineness of grinding, both before and after burning.
3. Tests for the tensile and compressive strength both with and without sand.
4. Requirements as to behavior in the presence of varying quantities of water.
5. A determination of the amount of each of the cementing constituents which may be present.
6. Requirements as to the speed and the order in which the hydration of the several constituents is completed.
7. A limitation as to the permissible change in quality resulting from age.
8. A requirement for soundness and constancy of volume.
9. A test for the completeness and uniformity with which the clinker has been burned.
10. A test for the time of "setting."
11. A requirement as to uniformity of mixture of the raw materials before burning.
12. A limitation as to permissible admixtures.
13. A limitation as to the use of water for the quenching of the clinker.

Before progress toward a better understanding of the factors which govern the inquiry can be made, it is advisable to list tentatively the characteristics of what may be termed the ideal cement. By so doing the desired goal will be kept clearly in view and, at the same time, the scope and character of the examinations and studies requisite to the solution of the problem will, in some measure, be disclosed. These characteristics may, in general, be stated as follows:

1. A maximum strength at a minimum of cost.
2. A maximum of density, durability and permanence.
3. A minimum of solubility both in and out of water.
4. A maximum of tensile strength under all conditions and in all directions within the mass.
5. A maximum of stability as against the development of internal stresses due to internal change of form.
6. A minimum of deterioration during storage, and
7. Within reasonably wide limits a minimum of susceptibility to variations in the quantity of mixing water.

At a later time there will be outlined the result of certain investigations and observations which, for several years, have been in progress in the laboratory of the Board of Water Supply, New York City. These investigations have been carried on, under the direction of the writer, by L. B. Stebbins, assistant to the chief engineer. It is hoped that the indications of these researches will be of value to all who are interested in the study of cement and that they will serve the purpose of pointing out a few of the many possible drections from which the problem, as a whole, can be approached.

Another Decision for Contractors on Engineers' Fraud

New York Appellate Division Upholds Claim That Barge Canal Engineers Knowingly Misrepresented Subsoil

A DECISION just rendered by the Appellate Division of the Supreme Court, State of New York, in a suit by a contractor on the State Barge Canal for reimbursement of losses, supports the views on misrepresentation and fraud by engineers set forth in the two contract suits reported in our issue of July 3, 1924, p. 21. The new case is very similar to the case of James Stewart & Co., there reported. However, while the latter was decided by the Court of Claims, the new case represents a higher-court decision, having gone to the Appellate Division on appeal from a judgment of the Court of Claims.

The case is that of Percy Jackson, trustee in bankruptcy of the United Engineering & Contracting Co., against the State. The Court of Claims found that the plans deceptively misrepresented the subsoil, but for legal reasons refused to allow a claim of $117,380.90 for increased cost of excavation due to this misrepresentation. It held that the plaintiff's claim is defeated by the paragraph in the contract which asserts that the contract is based on the contractor's own investigation of conditions, and disclaims any warranty or binding representation by the State in its estimates of quantity and statement of conditions (Par. 10, identical with the same paragraph in the Stewart case, quoted on p. 25 of issue of July 3, near foot of first column). The Appellate Division disapproves of this view, and interprets paragraph 10 of the contract as applicable only to "innocent mistakes."

Quoting from the decision of the Appellate Division:

The Court of Claims found the following facts: That part of the drawings of the contract were sheets nine and ten; that they were shown to the claimant's predecessor as information upon which to make its bid; that they showed that wash borings had been made and that the material to be excavated consists of

> sand, sand and clay, sand and gravel, red and black sand, gravel filling, rock, sand and stone;

that said information, with the plans and drawings, and bottles containing sand and gravel stated to have been taken from the wash borings, was the only information given to the claimant's predecessor; that the State had in its possession information as to rod soundings and wash borings made some years before; that they showed the material in question to be

> hard and firmly compacted, that it was composed of sand, clay and gravel or small boulders in one mass;

that the State failed to reveal to bidders any information in its possession as to the material to be excavated, except as shown on sheets nine and ten and the material in bottles; that there was time after the advertisement for bids and the submission of same for the claimant's predecessor to make some examination of the site, but not time to make a complete investigation of the subsurface conditions; that the claimant's predecessor relied upon sheets nine and ten in making its bid; that it provided proper tools and machinery to excavate the materials shown on sheets nine and ten; that such tools and machinery would not excavate the material found, and other tools and machinery were provided, and the material had to be blasted before it could be removed

> because said material was hard and compact and of a different character from that shown on sheets nine and ten of the contract plans;

that the investigation made by the State in 1895, 1900 and 1906 showed the existence of "hard compact material"; while sheets nine and ten showed only sand, clay and gravel; that the information given on sheets nine and ten constituted a misrepresentation of the conditions actually existing; that the claimant's predecessor was induced to enter into the contract by such misrepresentation; and that the increased cost of excavating the material found over what it would have been if the material had been as represented was $1.10 per cubic yard.

The findings of fact made by the Court of Claims contain all the elements of actionable fraud. . . . We think there is evidence to sustain the findings of fact, and that such findings are not against the weight of the evidence. We think also that the findings of fact required the Court of Claims to find as a conclusion of law that the claimant is entitled to recover for the item in question.

In construing the contract in question the same rules of construction are applicable as between individuals. . . . It takes no argument to demonstrate that such conduct on the part of an individual would constitute misrepresentation and fraud. It was more than a failure to state all the facts in the State's possession. It was a representation of a fact entirely contrary to the actual fact known by the State when the representation was made.

. . . A party to a contract cannot, by misrepresentation of material fact, induce the other party to the contract to enter into it to his damage and then protect himself from the legal effect of such misrepresentation by inserting in the contract a clause to the effect that he is not to be held liable for the misrepresentation which induced the other party to enter into the contract. The effect of misrepresentation and fraud cannot be thus easily avoided. If it could be, the implied covenant of good faith and fair dealing existing in every contract would cease to exist. . . . A contract to take a thing with all faults does not mean that it is to be taken with all frauds.

. . . It may be conceded that paragraph ten of the contract would afford protection to the State on a claim for damages because of an innocent mistake in the plans upon which bids were received. . . . In the case of Foundation Co. vs. State of New York, 233 N. Y. 177, the contractor sought to recover for the increased cost of excavation to bed rock because the boring sheet, not made a part of the contract but shown to the contractor for the purpose of enabling it to make up its bid, indicated that the bed rock was nearer the surface than it proved to be. It was held that no recovery could be had because the boring sheet was not a part of the contract, and if the bidder relied upon the boring sheet it did so at its own risk, as there was no bad faith, concealment of information, or misrepresentation, but an honest mistake on the part of the officers of the State.

In the instant case there are specific findings of fact that the State disclosed part of its information indicating that the material to be excavated was easy to excavate, but suppressed the fact that its investigations indicated that the material to be excavated consisted of a hard, compact mass, a great deal more expensive to excavate. It represented by its plans one condition when it had information of an entirely different condition. The Foundation Company case is not an authority for holding, under the facts in this case, that a recovery cannot be permitted.

Cross-Channel Car-Ferry Service Inaugurated

A development which is an outgrowth of the transportation conditions in Europe during the war is the inauguration of the Harwich-Zeebrugge car-ferry service, making use of the car ferries built for use between England and France during the war. The service provides direct rail connection between points in England and points on the Continent through the co-operation of the London & Northeastern Ry. and the Belgian State Rys. Special cars, which are designed to operate over both the Continental and the English railways which have slightly different gages, are being supplied by the Belgian Government. Two ferries are in use and six sailings each way will be made weekly. The car ferries have a capacity of 54 of the small 12-ton continental freight cars.

Vicissitudes of Garbage Disposal at New Bedford, Mass.

Fires and Explosion, Changes in Process and from Private to Public Ownership—Change to Incineration Recommended

DESTRUCTION by fire and explosion in its early years, at least three changes in the process employed, substitution of municipal for private ownership, entire interruption of operation for a period due to fire in June, 1923, with resultant incomplete operation since then are the main vicissitudes experienced at the garbage reduction plant established thirty years ago to treat the garbage of New Bedford, Mass. These facts are brought out in the report on what the city should do with its garbage in the future recently made to the city authorities by Samuel A. Greeley, of Pearse, Greeley & Hansen, engineers, of Chicago. The recommendation made, after a careful survey of all the governing local conditions, is that the best thing for the city to do is to dispose of the garbage in the future by incinerating it together with the rubbish of the city.

COMPARATIVE FIRST AND YEARLY COSTS OF VARIOUS SYSTEMS OF GARBAGE DISPOSAL FOR NEW BEDFORD, MASS.

Based on an average of 43 tons per day of garbage only and 63 tons per day of garbage and rubbish combined.

Method	Total Cost	Average Yearly Cost Per Ton
Incineration:		
Garbage only	$80,000	$2.48
Garbage and rubbish	120,000	1.92
Reduction, Cobwell-Merz system	172,500	2.95
Beccari fermentation process	190,900	1.09
Hog feeding	162,000	0.90
Present method developed	35,000	3.00

The first garbage reduction plant at New Bedford was built in 1894. It was of the Holthaus type. In 1904, "some years" after the first plant had been destroyed by fire and explosion, a reduction plant making use of the Wheelright hot-water reduction process was built by the New Bedford Extractor Co. This plant was continued in operation for about ten years. It was taken over in April, 1914, by a new company which substituted the Cobwell system, completing the rebuilt plant during 1915.

Municipal Operation—In the winter of 1921 the Cobwell plant was bought by the city of New Bedford for $156,400, including the right to use the Cobwell process. The city began operating the plant early in March, 1921. To increase the capacity of the plant a drier was installed as a preliminary to treatment in the Cobwell tanks, the combination being known as the Cobwell-Merz process. On June 23, 1923, the plant took fire, but on the following day a drier was reclaimed and installed. Since that time, according to Mr. Greeley's report, "garbage has been disposed of more or less regularly by drying." In the spring of the present year "practically all of the dried garbage" was being taken by farmers for use as a fertilizer.

During 1922 the reduction plant was out of use 1 day in May, 3 in June, 4 in July, 25 in August, 7 in September, and 5 in November, making a total of 45 days. Up to June 23, 1923, when the fire occurred, the plant had been out of operation 1 day in January, 9 days in March, 1 day in April, 22 days in May, and 5 in June, a total of 38 days in a little less than a half year. During the interruptions in operation of the reduction works, Mr. Greeley states in his report, "some garbage has been buried on fields adjacent to the plant."

The population of New Bedford is estimated at 148,000 in 1928 and 184,000 in 1940. For the year 1928, estimating 180 lb. of garbage, 80 lb. of rubbish, and 773 lb. of ashes per capita per year, there would be offered for disposal daily 43 tons of garbage, 200 tons of ashes, and 19 tons of rubbish, or an average of 262 tons altogether.

The estimated construction cost and also the average yearly cost per ton, the latter after deducting estimated revenues, for the several processes considered, are given in the accompanying table.

Commenting on these figures, Mr. Greeley says in his report:

> In accordance with the estimates of cost for New Bedford conditions, the disposal of garbage by incineration is cheaper than by reduction. Disposal by feeding to hogs and by the Beccari process may be less costly if favored with continuous operation and a ready sale of the product. However, the uncertainties of these two processes do not commend them at the present time. Disposal by the present method is more costly than by incineration. For these reasons and in view of the further advantage of disposing also of rubbish, we recommend incineration as the permanent solution of the garbage disposal problem in New Bedford.

Mr. Greeley recommends that rubbish be collected separately once in ten days in special wagons having a capacity of about 12 cu.yd. each. He also advises that the proposed incinerator be located at the site of the present garbage reduction plant; that the incinerator should be of a simple form; and that the bids should be based on "specifications clearly describing the general character of the incinerator and the material of which it is to be built."

The plant should have a capacity of 100 tons a day in order to take care of the estimated amount of garbage and rubbish estimated to be produced in 1940. It is assumed that the chimney of the old reduction works could be used. By using the old chimney and also utilizing some of the foundations of the old reduction plant, it is believed that the cost of $120,000 estimated for an entirely new plant could be reduced to $90,000 including the runway.

Mexican Timber for American Railway Ties

Interest in the commercial pines of the Sierra Madre region of Mexico as a possible source of timber for railway ties has led the dendrologists of the U. S. Forest Service to examine recently a number of specimens of the wood grown in that region. These specimens were found to be all of the *Pinus ponderosa arizonica*, a form closely related to our western yellow pine. This variety has an extensive range in the Mexican provinces of Sonora and Chihuahua, and occurs in small areas in the mountains of southern Arizona. If cut within our borders, the Arizona pine would probably be marketed with the true western yellow pine, from which the wood differs, however, in being heavier and harder. Wood of the Mexican-grown timber bears a rather remarkable superficial resemblance to some grades of the longleaf pine of the Southern States. In order to determine for those particularly interested in the use of this timber for railway ties what are its comparative physical properties, arrangements are being made for the Forest Products Laboratory, at Madison, Wis., to test short cross-sections of the wood.

Automatic Signal Lamp Devised For Triangulation Surveys

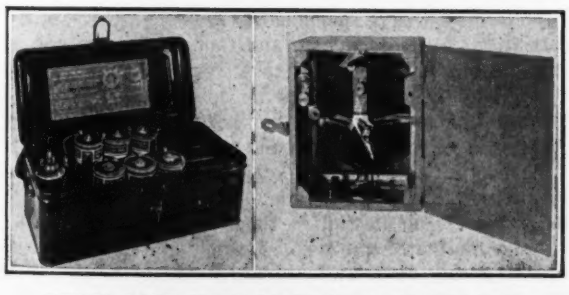
Portable Unit Weighing But 17½ Lb. Burns Maximum of 6 Hr. Daily For 8 Days With Single Adjustment

By D. L. Parkhurst
Chief, Instrument Division, U. S. Coast and Geodetic Survey, Washington, D. C.

THE ACCURACY required in the precise triangulation surveys made by the U. S. Coast and Geodetic Survey is such that the greater part of the work must be done at night to avoid errors caused during the day through irregular horizontal refraction of the light rays. For such night work, the surveying instrument is sighted on an electric signal lamp (often many miles away) which throws a powerful beam of light.

The Coast and Geodetic Survey has recently developed an automatic lamp for this purpose which is very light, compact and economical to operate. A standard automobile spotlight reflector is used for a basic part and the automatic lighting mechanism is so arranged that the lamp will burn only a limited number of hours each evening, thus conserving the battery. It will operate for a week without attention. The lamps are operated by dry cells as these have been found to be the lightest and most economical source of electric current. The lamps are designed so that two or more may be fastened one above the other by screws located directly above and below the focal point of the reflector. The lamps can then be pointed toward different stations and observations made on the point by two instruments at the same time.

The lamp is contained in a small wooden box reinforced internally by a rectangular aluminum casting in which the spotlight reflector is suspended on two studs, placed in line with the focal point. A slow motion screw is provided so that the reflector may be tipped through a small angle to facilitate pointing in the direction of the surveying instrument. The pointing is done by means of a telescoping peep sight. Protection from



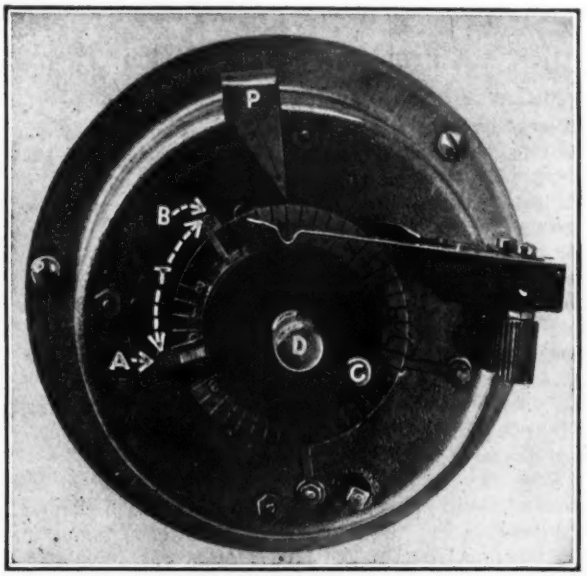
SIGNAL LAMP WITH LIGHTING UNIT AT LEFT

inclement weather is afforded by steel doors at front and back, the forward door having a glass covered opening. A cable outlet is provided in the side.

The automatic lighter is made up of a special switching mechanism designed by the Coast and Geodetic Survey and a standard eight-day clock, the time shaft of which revolves once each 24 hours, mounted in a standard pressed steel automobile tool box arranged to hold the necessary number of dry cells. A cable outlet is provided in the side of the box so that no extra protection is needed from the weather.

The switch consists of two plates each bearing cams, the arc of which is 45 deg., corresponding to three hours of time. These plates can be adjusted with reference to each other so that the arc during which contact is made with the spring brush may be a minimum of three hours or a maximum of six hours.

When setting, the cams are adjusted to the desired length of time the light is to burn, the forward knife edge is placed on the hour at which the lamp is to light, and the whole switch clamped by means of the center screw with the pointer on the clock indicating the time of day at which the setting is being made.



TIME SWITCH FOR AUTOMATIC SIGNAL LAMP

Switch is set as follows: Thumb screws *C* and *D* are first loosened. Bevelled edge of *A* is held on any hour and *B* is moved around until the arc *T* represents the number of hours it is required to let the signal burn. Screw *C* is then tightened to hold *A* and *B* fixed. The entire switch is then turned until the pointer *P* indicates the time of day at which the setting is being made. The dial is then held firmly until the arm *A* is on the hour at which the lamp is to light. Screw *D* is then tightened. Light-colored half of dial indicates A.M., dark P.M.

The lamp and lighter weigh but 17 lb. without battery and form a compact and portable outfit, particularly valuable for work in mountainous regions where pack animals cannot be used.

Little Iodine, Much Goiter at Chicago

In view of the discussion during the past year on the treatment of water supplies with sodium iodide as a means of preventing goiter in localities where goiter is endemic and the local water supply has less than the normal content of iodine, it is interesting to note that "Chicago has, conservatively, 200,000 persons suffering from preventable goiter, the greatest number occurring between the ages of birth and sixteen years" and that "the iodine content of Lake Michigan water has been determined to be from 0.281 to 0.681 parts per billion. These statements are taken from an exordium, entitled "Give the Child a Chance" by Dr. Herman N. Bundesen, commissioner of health, Chicago, in the *Weekly Bulletin* of the Chicago Department of Health, June 14, the circulation of which "exceeds 500,000" for this particular issue. Dr. Bundesen further states that Chicago "is in the area of lowest iodine content and highest goiter incidence in the United States."

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A Problem in Conservation

Sir—Why do authors write their books on the assumption that the reader is interested in only one subject, owns only one book, and having once read that book will never read another book on that subject, or at least will never forget any detail thereof? For instance, suppose you have occasion to take up some particular subject which has not come up for several years. Well you grab your old . . . from the shelf, blow off the dust and skim through the pages until you find your subject matter. Here it is, formula and everything. FINE! But hold on a minute. Let's see: Of course L and D are obvious, but what in heck is L_e? And D_s is, is . . . ? Here ensues a mad scramble through the book. Your one consolation is that there are no ladies present.

Now why could not the author put either in the front of the book, or at the beginning of each chapter, if needed, a list of the symbols he intends to use in that chapter, so that the reader could get at what he wanted at *any time*, without having to read from "Preface to First Edition" to "List of Books by the Same Author"?

The writer is deeply interested in the conservation of Cuss Words. Any help that can be rendered will be appreciated. E. K. D.

Stockton, Calif., June 30, 1924.

Epoch-Marking Plumbing Studies

RECOMMENDED MINIMUM REQUIREMENTS FOR PLUMBING IN DWELLINGS AND SIMILAR BUILDINGS: Final Report of Subcommittee on Plumbing of the Building Code Committee, July 3, 1923—George C. Whipple, chairman, Harry Y. Carson, William C. Groeniger, Thomas F. Hanley, Albert E. Hansen; John M. Gries, chief, Division of Building and Housing, Frank P. Cartwright, technical secretary, R. B. Hunter, in charge of tests—[United States Department of Commerce, Elimination of Waste Series.] Washington, D. C.: Bureau of Standards. Paper; 6 x 9 in.; pp. 260, graphs and plumbing layouts. 35c. from Superintendent of Documents, Washington, D. C.

After some two years of painstaking investigation, the plumbing subcommittee of the Building Code Committee of the United States Department of Commerce, working in collaboration with the Bureau of Standards, has produced a report which is destined to mark another epoch in the evolution of plumbing design and control from a craft to a branch of engineering science. The investigation now under consideration has taken into account the administrative phases of plumbing control by states and municipalities and also the economic aspects.

A word deserves to be said of the composition of the committee. Its chairman, George C. Whipple, is professor of sanitary engineering in Harvard University and was for a number of years a member of the Massachusetts Public Health Council. Mr. Carson is research engineer of the American Cast Iron Pipe Co. Mr. Groeniger is a consulting engineer of Columbus, Ohio. Mr. Hanley is a member of a firm of mechanical engineers and contractors at Chicago and chairman of the Standardization Committee of the National Association of Master Plumbers. Mr. Hansen is a hydraulic and sanitary engineer of New York City. Originally there were three other members of the committee, of whom a footnote in the report states that "Circumstances not related to the work of the subcommittee compelled their resignation." Two of these members, however, did not resign until the committee had issued a tentative report to elicit discussion. These two members were William J. Spencer, secretary-treasurer of the building trades department, American Federation of Labor, Washington, D. C., member of the United Association of Journeymen Plumbers, and Albert L. Webster, consulting engineer, New York City. The third member of the committee who has resigned and the first to submit his resignation (within a short time of the appointment of the committee) was James A. Messer, of Washington, D. C. Regarding Mr. Spencer, it may be added that although he dissented from the preliminary report of June 17, 1922, and submitted a minority report in favor of individual venting for traps, he concurred in all the rest of the tentative report.

The report is so readily obtainable and at such a nominal price that little will be attempted here in the way of a notice beyond outlining its contents and calling attention to its importance to those concerned in any way with plumbing, housing, and public health, and to the competency of those who took part in the investigation.

The report first sketches the history of the investigation, the relation of plumbing to health and the present status of plumbing regulations, and then gives a very concise statement of basic plumbing principles. Next, a Recommended Plumbing Code for Dwellings and Similar Buildings is presented. This is followed by a section entitled Experimental Investigations, Standardization, Administration, and Comment. Appendices give the minority report of Mr. Spencer, already mentioned, and a reply to it made by those signing the present report; a review of Corrosion of Metals in Plumbing Systems, by Professor Whipple; a study of air currents in horizontal waste pipes, detailing a series of experiments by Warren E. Holland at Harvard University; and a reprinting in full of the standard specifications of the American Society for Testing Materials for the following materials and standard sizes: Clay sewer pipe, cast-iron soil pipe and fittings, welded wrought-iron pipe, welded and seamless steel pipe, and standard sizes for brass and for copper pipe.

As examples of some of the advances made by the report, mention may be made of the establishment of unit discharge loads (volume in a given time) as a basis for sizes of various pipes entering into plumbing and the use of the probability method of determining peak loads in a plumbing system. As examples of simplified practice and of economies proposed by the subcommittee, it may be stated that although it is not proposed entirely to eliminate back venting of every fixture, methods are suggested for a considerable elimi-

nation; and that the investigations are regarded as having established the fact that a 3-in. stack is sufficient in size not only for ordinary dwellings but probably for much larger structures as well. It should be added that although the report is concerned primarily with small dwellings it contains many data applicable to larger buildings of all classes.

Finally, the report may well be obtained and studied not only by those directly interested in plumbing but also by sanitary and hydraulic engineers as a class.

Points in Mapping Large Areas

REVIEWED BY HUGH C. MITCHELL

Mathematician, U. S. Coast & Geodetic Survey, Washington, D. C.

EFFECT OF VARIATIONS IN THE ASSUMED FIGURE OF THE EARTH ON THE MAPPING OF A LARGE AREA—By Walter D. Lambert, Mathematician, U. S. Coast & Geodetic Survey. Special Publication No. 100, Serial No. 258. Washington, D. C.: U. S. Coast and Geodetic Survey. Paper, 6 x 9 in.; pp. 35; line cuts and mathematical tables. 5c. from Superintendent of Documents, Government Printing Office, Washington, D. C.

The geodesist and the engineer will alike be keenly interested in this monograph on what is usually considered a distinctly scientific problem, but which is here treated from a broad engineering and economic viewpoint. There are already published geographic positions of some 20,000 points in the United States, and perhaps positions for 16,000 more are computed and ready for publication. These positions are all on the standard geodetic datum, the North American Datum, which has for its reference spheroid the Clarke Spheroid of 1866 as expressed in meters. Depending on these many positions are all the charts of the Coast & Geodetic Survey, of the Lake Survey, the topographic map of the United States which has been under construction by the U. S. Geological Survey for a number of years, and is now nearly half completed, many surveys by the U. S. Army, by state organizations, and by cities. There are also co-ordinated on this standard geodetic datum a number of boundaries, international, state, and county. The present consideration by Congress of the Temple bill, a bill intended to expedite the making of the base topographic map of the country, makes the appearance of Mr. Lambert's study very timely and appropriate.

To change the adopted reference spheroid, or even the standard geodetic datum, would mean an almost herculean task of recomputing the many geographic positions already available, and even where maps based on these positions would suffer no distortion, they would have to be revised and the graticules, networks of parallels and meridians, either shifted to their new positions or else given new designations in all probability involving fractional numbers corresponding to their new values. The first method would involve considerable labor, the second would be but a makeshift expedient. But even more serious might be the difficulties arising where a given boundary is defined as a stated parallel or meridian, and a shifting to a new spheroid of reference displaces that line so that it no longer coincides with the line on the ground. Complications difficult to foresee might easily arise from such a case.

It is interesting to note that while the 1909 determination of the spheroid by Hayford is probably the most accurate yet obtained, being so near the truth that only small changes in its elements may ever be expected, the U. S. Coast & Geodetic Survey continues to use the Clarke spheroid of 1866 as expressed in meters, and the North American (geodetic) datum, which spheroid and datum have both been adopted by our neighbors, Canada and Mexico, for their geodetic work, thus adding many more geographic positions on this datum to the numbers given above, constituting additional reasons against any changes in the reference spheroid.

Mr. Lambert concludes that while for geographic purposes a change would not be justifiable, another answer to the question may be had when it is considered from the purely scientific viewpoint of determining a newer and better value for the figure and the size of the earth—an answer that may well remain unsought until practically all of North America is on the standard datum, and the evidence on which to base the inquiry considered as complete. With the rapid progress now being made in the fundamental control surveys of this country and of its near neighbors the day for tackling this question may not be so remote as one would think.

Mr. Lambert also gives a solution for a special case of the problem of computing the latitude and longitude of a point, given its distance and azimuth from a point of known position. This is for those cases where the distance between the two points is very great, and the exact formula ordinarily used in geodetic work becomes too complex for easy computation. The inverse of this problem, where the positions of the two points are known and the distance and bearings between them are desired, should be of great interest to the many people who are now working with radio and who desire to know the distance they are from a broadcasting station. For each of these problems, the direct and the inverse, a numerical problem, easy to follow, is worked out.

Addresses on Super Water Power

SUPER-POWER AS AN AID TO PROGRESS—By Guy E. Tripp, Chairman of the Board of Directors, Westinghouse Electric & Manufacturing Co. New York: G. P. Putnam's Sons. Cloth; 5x8 in.; pp. 61; hydro-electric power development maps and photographs. $1.25.

Mr. Tripp has collected addresses made by himself during the past year or two. The titles are Electrification in North America, Private Ownership versus Government Ownership of Super-power Systems, What American Water Power Will Do for the American People, Water Power and Statesmanship, States Must Not Isolate their Water Power, and Super-power as an Aid to National Defense. It is a defense of private ownership of power against public ownership and an exposition of the thesis that water power will eventually constitute the critical element in human progress.

New Edition of Rushmore and Lof

HYDRO-ELECTRIC POWER STATIONS—By David B. Rushmore and Eric A. Lof. [Second Edition.] New York: John Wiley & Sons, Inc. Cloth, 6x9 in.; pp. 830; 437 halftones and line cuts. $7.50.

Good books on hydro-electric power development are scarce. The subject is comparatively new and its development rapid so that the textbook writers have been hard put to it to keep step. The Rushmore and Lof book first appeared in 1917. The present edition is brought up to September of 1923. With the additions noting the improvements of the past seven years it is a remarkably complete textbook of the many specialties which are included under the general term, hydro-electric engineering. Necessarily one book cannot contain all of the technique of such subjects as

hydrology, dams and headworks, water conductors and accessories, storage reservoirs, power house design, hydraulic equipment, electric equipment, economic aspects and organization and operation, which are the subheads of the book, but the authors have managed to cover the various divisions in excellent fashion. As would be expected from the authorship it leans rather more to the electric operation than to the hydraulic but for that very reason it should be useful to the civil engineer who is better acquainted with the hydraulic than the electric side of hydro-electric development.

Secretary Mellon on Taxation

TAXATION: THE PEOPLE'S BUSINESS—By Andrew W. Mellon. New York: The Macmillan Co. Cloth; 5x8 in.; pp. 229; statistical tables. $1.25.

The theory of taxation advocated by the Secretary of the Treasury is, or should be, sufficiently well known to the people of the United States so that there is no need for further defining it. It does serve a useful purpose, however, for Mr. Mellon to explain in detail the reasons for the theory and the observations as to the results of current taxation methods which have led him to the theory. This he has done in his little book. Briefly, Mr. Mellon says that a sound tax policy must first produce sufficient revenue for the government; second, must lessen so far as possible the burden of taxation on those least able to bear it; and third, must also remove those influences which might retard the continuous development of business and industry on which, in the last analysis, so much of our prosperity depends. These three principles will be approved probably even by the most violent of the Democratic opponents to the Mellon theory of taxation. The rock on which the Mellon plan split was the super-tax, the reduction of which the Democrats believe to be a mere sop to the rich man and which Mr. Mellon sets out to prove in his book only results in a diminution of the tax stream to the government and a bypassing of capital from productive to non-productive fields.

State and Local Finance

PROBLEMS OF PUBLIC FINANCE—By Jens P. Jensen, Department of Economics, University of Kansas. [Crowell's Social Science Series.] New York: Thomas Y. Crowell Co. Cloth; 6x8 in.; pp. 606. $3 net (postage extra).

STATE AND MUNICIPAL BONDS—By William L. Raymond, Author of "American and Foreign Investment Bonds." Boston: Financial Publishing Co.; London: George Routledge & Sons, Ltd. Cloth; 6x9 in.; pp. 388; many statistical tables. $4.

SCHOOL BONDS—By John Guy Fowlkes, Ph.D., Associate Professor of Education, University of Wisconsin. Milwaukee, Wis.: The Bruce Publishing Co. Cloth; 6x9 in.; pp. 176; inserts of bond forms.

Professor Jensen's Problems in Public Finance is an up-to-date review in sufficient detail for the general student of the subject whether in or out of school. It presents objects, governing factors and effects of public expenditures; takes up the various sources of public revenue, including the many kinds of taxes, their history, advantages and disadvantages; considers public credit or borrowing; and closes with several chapters on fiscal administration. Foreign as well as American experience and current practice are considered. Pertinent statistical data are given.

Mr. Raymond says in his Preface that his State and Municipal Bonds "has been written after more than twenty-one years of practical experience in the investment bond business." The book appears to be addressed primarily to bankers and investors, and secondarily to students of public finance. The volume is divided about equally between state and municipal bonds. A short section is devoted to taxation of state and local securities. The general plan followed is to review the history and present status of the two main classes of bonds discussed, including constitutional and statutory limitations, volume and objects of indebtedness, and tendencies of growth. Liberal use is made of Census Bureau publications and of the State and Municipal Section of the *Commercial and Financial Chronicle*. In fact, this material, with the summaries and comments based upon it, makes up the bulk of the volume.

School Bonds, by Professor Fowlkes, is designed as a handbook for those responsible for or who assist in the issuance of school bonds. The author expresses the hope that, in addition, the book will be helpful in matters of school bond legislation and to teachers of and students in school administration. The volume contains much information and sound opinion within its stated field, some of which is applicable to any class of municipal bonds. There is an abundance but not a superfluity of statistical summaries.

Concrete, Plain and Reinforced

REINFORCED CONCRETE AND MASONRY STRUCTURES—Compiled by a Staff of Specialists; Editors-in-Chief: George A. Hool, Consulting Engineer, Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, Professor of Structural Engineering, University of Wisconsin. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 786; 536 line cuts and halftones. $6.

There is only one complaint to be made about this book; that is, the inclusion of masonry in the heading. The text is the most complete yet published on reinforced-concrete structures. It has very little reference to masonry, though of course reinforced concrete means concrete from the materials that make it up through the methods of making and placing it and the methods of designing it. The book is one of a series "designed to provide the engineer and student with a reference work covering thoroughly the design and construction of the principal kinds and types of modern civil engineering structures," and is the work of a number of associates, all specialists in their particular field. It is difficult to conceive of a more complete treatment of the theory and practice of concrete and reinforced concrete. It is sufficiently theoretical to satisfy the demands of those who want to know the reasons for design and sufficiently practical for those who want to know how to do the thing regardless of the reasons for doing it.

The Russian Problem

RUSSIAN DEBTS AND RUSSIAN RECONSTRUCTION: A Study of the Relation of Russia's Foreign Debts to Her Economic Recovery—By Leo Pasvolsky and Harold G. Moulton, with the aid of the Council and Staff of the Institute of Economics. [The Institute of Economics Series.] New York and London: McGraw-Hill Book Co., Inc. Cloth; 5 x 8 in.; pp. 247; $2.50.

To many persons concerned in post-war problems a subject second in interest only to Germany's Capacity to Pay is treated in the later volume in the same series, Russian Debt and Russian Reconstruction. The authors reach three conclusions of particular interest to Americans: (1) "The direct trade of the United States with pre-war Russia was very limited"; (2) "there is no ground for believing that an extensive trade can be developed between the United States and Russia"; (3) "the safety of American investments in Russian

securities would depend primarily upon the recovery of Russian markets in Central and Western Europe." That is, the financial and economic recovery of Russia is of more indirect than direct moment to the United States. As might be expected, the authors are unable to suggest a way out for Russia except through internal reform, followed by international co-operation rather than by exploitation, whether by government or private interests.

PUBLICATIONS RECEIVED

THE MINERAL INDUSTRIES OF CANADA is the title of an attractively illustrated pamphlet issued by the Department of Mines, Ottawa, Canada, for circulation at the British Empire Exhibition.

A PAPER on The Indictment and Suits Against Cantonment Constructors, by Frank M. Gunby, President, Boston Society of Civil Engineers, has been reprinted from the *Journal* of the Society (Boston, Mass.).

THE NINTH REPORT of the Committee for the Investigation of Atmospheric Pollution, associated with the Meteorological Office of the British Air Ministry, has been published as a 59-p. blue book (London: H. M. Stationery Office; 4½s. net in England). Measurements of deposits at various stations by the standard gage, results by an automatic filter and by a jet dust counter are reported, as also researches on the effect of atmospheric pollution upon visibility. There are some notes on a new form of deposit gage.

A NEW PAPER entitled "Ports & Waterways," a national review of marine development, construction and transport facilities, was started with its first number July, 1924, in Chicago, 10 South La Salle St. The editor is Harwood Frost, the son of the late George H. Frost who was the founder of *Engineering News*. The first number is devoted largely to the waterways surrounding Chicago and the port of Chicago, although there are articles by George F. Nicholson on "Fire Protection at Marine Terminals," and W. L. Harding on "Waterways and Transportation."

TO SAVE TIME in answering requests for descriptive matter on the water-works system of Chicago, received from engineers, water-works officials, students and others, a pamphlet of 32 pp. on the water-supply system of Chicago has been prepared by John Ericson, city engineer, under date of April, 1924. Opportunity has been seized to prevent adverse remarks on high water consumption and waste in Chicago, which exceeds 275 gal. per capita per day, and on the need for meters.

UNDER A CO-OPERATIVE AGREEMENT between the University of Illinois and the National Warm-Air Heating and Ventilating Association, the fourth of a series of bulletins on Warm-Air Furnace Research has been published (Engineering Experiment Station, University of Illinois, Urbana; 162 pp.; 85c.). The present bulletin is by A. C. Willard, Professor of Heating and Ventilation, and two associates.

A COMMITTEE of the American Association of Engineers, headed by A. B. McDaniel, worked for the better part of a year in preparing the minimum specifications for highway engineering positions which have now been published as one of the bulletins of the National Research Council under the auspices of the Advisory Board on Highway Research of the Council. The committee studied the highway engineering field and prepared an occupational study sheet form which was sent out to 2,700 highway engineers. From the data so obtained they first classified the kinds of engineers engaged in highway work and then specified the requirements for each class. The program is to set up for each class minimum specifications which first state the requirements under the headings Skill, Knowledge and Personal, and then puts a number of problems which it is assumed the engineer in the position specified shall be able to answer or solve.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

AMERICAN AGRICULTURE AND THE EUROPEAN MARKET: By Edwin G. Nourse, with the Aid of the Council and Staff of the Institute of Economics. [Publications of the Institute of Economics.] New York and London: McGraw-Hill Book Co. Cloth; 5x8 in.; pp. 333; 47 line charts. $2.50.

COMPENDIUM OF BUILDING DATA FOR ARCHITECTS, ENGINEERS AND BUILDERS: A Practical and Thoroughly Reliable Hand Book for All Those Engaged in the Building Business Who Design, Estimate or Build—Compiled and Edited by J. Soman, B. S. C. E. New York: Jual Publishing Co. Paper; 8x11 in.; pp. 18; charts and tables. $1.

CRAIN'S MARKET DATA BOOK AND DIRECTORY OF CLASS, TRADE AND TECHNICAL PUBLICATIONS: Fourth Edition, 1924. Chicago: G. D. Crain, Jr., 537 S. Dearborn St. Cloth; 6x9 in.; pp. 505. $5.

Descriptive and statistical information regarding sales outlets for many kinds of industrial products is followed by pertinent details regarding the technical and trade journals serving the corresponding fields. The "market" articles—Architects, Building Construction, Chemical Industries, Engineering Construction, Municipalities, etc.—give a general and statistical survey of the profession or industry and the corresponding goods used. Alphabetical indexes of materials, publications and advertisers make the contents of the volume readily available.

DRYING BY MEANS OF AIR AND STEAM: Explanations, Formulae and Tables for Use in Practice—By E. Hausbrand, Author of "Evaporating, Condensing and Cooling Apparatus." Translated from the German by A. C. Wright. Third Revised English Edition. London: Scott, Greenwood & Son. New York: D. Van Nostrand Co. Cloth; 5 x 7 in.; pp. 77; charts, line drawings and statistical tables. $2.50.

A brief mathematical discussion, with working tables, all based on the metric system. The first edition in English appeared in 1901.

ELASTICITY AND STRENGTH OF MATERIALS USED IN ENGINEERING CONSTRUCTION: Section IV, Columns, Elastic Theory and Economic Design and Analysis of Eye Bars, Pin and Rivet Connections—By C. A. P. Turner, Consulting Engineer, M. A.S.M.E., M. A.S.T.M., M. A.S.C.E. Minneapolis, Minn.: C. A. P. Turner, 300 Builders Exchange. Cloth; 7 x 10 in.; pp. 134; 25 line cuts and halftones; structural tables. $5.

ELECTRICAL MEASURING INSTRUMENTS AND SUPPLY METERS—By D. J. Bolton, B.Sc., A.M.I.E.E.; Lecturer in Electrical Engineering, The Polytechnic, London. [Directly-Useful Technical Series.] New York: E. P. Dutton & Co. Cloth; 6 x 8 in.; pp. 328; 180 halftones and line cuts. $5.

THE GOVERNMENT OF SPECIAL CHARTER CITIES IN IOWA.—By George F. Robeson. Iowa City, Iowa: State Historical Society of Iowa. Cloth; 6x9 in.; pp. 286. $2.

A well executed "historical and descriptive discussion of the organization, powers and functions of the cities operating under special charters," covering the period from 1838 to 1923. Chiefly academic, since only five of the cities granted special charters before the constitutional prohibition of such legislation in 1857 remain under the original charters—Davenport, Muscatine, Glenwood, Wapello and Camanche—and those cities now have the benefit of a large amount of legislation applicable to all the municipalities in the state.

THE NEW INTERNATIONAL YEAR BOOK: A Compendium of the World's Progress—Editor, Frank Moore Colby, M.A. New York: Dodd, Mead & Co. Cloth; 7 x 10 in.; pp. 815; 16 halftone plates and 8 maps. $6.75.

As usual, this year book gives a goodly amount of space to the various branches of engineering and allied industrial subjects. Aeronautics, civil engineering and manufacturing are covered by Herbert T. Wade, Late Captain, Ordnance Department, U. S. A.; naval matters by Captain Lewis S. Van Duzen, U. S. N. Retired; Physics by Henry D. Hubbard, Secretary, U. S. Bureau of Standards; and sanitary engineering and municipal subjects by M. N. Baker, Associate Editor, *Engineering News-Record*.

PRACTICAL MATHEMATICAL ANALYSIS—By H. Von Sanden, Professor of Mathematics at the University of Clausthal; With Examples by the Translator, H. Levy, M.A., D.Sc., F.R.S.E., Professor of Mathematics, Imperial College of Science and Technology, London. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 195; 27 line drawings. $4.50.

THE REGULATION AND THE MANAGEMENT OF PUBLIC UTILITIES—By Charles Stillman Morgan. [Hart, Schaffner and Marx Prize Essays in Economics.] Boston and New York: Houghton Mifflin Co. Cloth; 5x8 in.; pp. 362. $2.50.

TRINK UND BRAUCHWASSER—Von Prof. Dr. Hartwig Klut, Wiss. Mitglied der Preussischen Landesanstalt für Wasser-Boden- und Lusthygiene, Berlin-Dahlem. Berlin and Vienna: Urban & Schwarzenberg. Paper; 6x9 in.; pp. 129; 11 line drawings. 3.6 gold marks in Germany.

VARNISHES AND THEIR COMPONENTS—By Robert Selby Morrell, M.A., Ph.D., F.I.C., Formerly Fellow of Gonville and Caius College, Cambridge; Research Chemist at Messrs. Mander Bros., Wolverhampton, England. [Oxford Technical Publications.] New York: Oxford University Press, American Branch. Cloth; 6 x 9 in.; pp. 361; 43 line drawings. $8.35.

Designed "to present a summary of the recent advances in the study of varnishes and their components," chiefly from the manufacturer's viewpoint, but contains material on the application of varnishes, their defects, etc.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Fire Tests of Paints

Sir—We note in your issue of July 3, 1924, p. 37, an item stating that the Bureau is making fire tests of a certain proprietary paint. While it is true that we had tentatively outlined a program including fire tests of wood shingles painted with a number of so-called fire retardent paints and also with paints made up according to usual formulas, we have on further consideration eliminated these tests from the present series as not being of essential importance for the purpose for which the present tests of roofing are conducted, which concerns mainly information needed for municipal regulations in the use of roofing materials. It is generally not possible for building officials to regulate paints in the matter of first application, kind of paint, nor to determine the degree of weathering permissible before repainting is necessary, and it appears therefore that the tests with the unpainted shingles would give all the information necessary for the present purpose.

From previous work on the same subject we believe that paints generally have some fire retardent value in preventing initial ignition and to a minor degree initial spread of fire where the source of heat is not large. The protection afforded is, however, severely limited by the thinness of the film and its rapid destruction at temperatures produced around the area of a fire that has attained any appreciable proportion. It also appeared that the difference in results obtained with different kinds of paint is not large, since to be serviceable and have proper weathering resistance the paint composition cannot vary greatly from generally accepted formulas. It is intended when some of the investigations at present in progress are completed to take up the matter of paints and fire retarding treatments in greater detail as it concerns all general uses, including that of roofing.

GEORGE K. BURGESS,
Director, U. S. Bureau of Standards.

Washington, D. C.,
July 10, 1924.

Cover for Concrete Reinforcing Steel

Sir—The writer was intensely interested in the article by A. S. Woodle, Jr., in your issue of June 26, p. 1092, on the proper cover for steel reinforcement in concrete. Although the author says, "it is intended that this examination be qualitative in character rather than quantitative," the writer would like to point out how large an error has been brought into the solution by not taking into account all the factors of the problem.

The assumption that the concrete cover over a reinforcing bar is a beam acted upon by a force produced by the relative thermal expansion of concrete and steel is quite ingenious and probably a fair approximation of the true condition. However, in a beam of span d and depth c, the flexural deflection is a small part of the total deflection. It is exceeded by both the shear deflection and the elastic deformation. Assuming, with the author, that the concrete forms a simple span, the total deflection is

$$y = \frac{5\ W\ d^3}{384\ E\ I} + \frac{5\ W\ d}{36\ A\ G} + \frac{W}{E\ d},$$

where the first term is due to flexure, the second to shear and the last to elastic compression. A is the cross-sectional area of the beam, G is the modulus of elasticity of concrete for shear, sometimes called the modulus of rigidity. This is *not* the value often called the modulus of rupture, which is really the ultimate strength in shear. The elastic modulus for shear is approximately 0.4 E [based upon the few experiments upon the determination of the elastic modulus in tension T and the Poisson ratio p, from the formula, El.Mod.Shear $= T/2(1 + p)$]. The full elastic compression will not occur; its effect is separated from the rest in the computations below.

Following the method of the author, there results the fiber stress,

$$f = \frac{10{,}800\ c\ d^3}{45\ d^3 + 100\ c^2 d + 288\ c^3}$$

For a 1-in. square rod, with one inch of concrete cover, this equation shows a tensile stress of 25 lb. per square inch in the concrete. If the elastic compression is entirely disregarded, the result is 75 lb., and if the shear deflection is also disregarded, f is 240, the same result as is obtained by the author.

Disregarding the shear deflection is quite common, since its effect is so small in the usual type of beam. However, in short spans of great depth (comparatively), the shear deflection is quite important and must be considered, for example, in such structures as vertical lift gates, short heavy shafts, etc. The effect of the span depth ratios can be seen from the following comparisons for:

1. A simple rectangular beam with a concentration at the center:

Ratio span to depth	5	10	20
Ratio shear to bending deflection	0.12	0.03	0.0075

2. A steel shaft, circular section, uniformly loaded:

Ratio span to depth	5	10	20
Ratio shear to bending deflection	0.067	0.016	0.0042

The assumption of a simple span has no real basis; any restraint or continuity decreases the flexural deflection without altering the other factors.

JACOB FELD,
Professional Engineer.

New York City, July 8, 1924.

Speeding Up Hydro-Electric Construction

Sir—Can one eat one's cake and have it too? An affirmative answer seems to be given in the editorial entitled "The Economy of Speed" on p. 962 of your issue of June 5. I fear me that the engineer of the hydro-electric project there mentioned would do well to avoid counting on both income from sale of power and on saving in interest charges. Instead of $5,384 per day, the gain, based on the figures there given, can hardly exceed $2,700 per day and is likely to be only half that amount.

Assume that by the original plans the project is started, say, January 1, 1924, and finished two years later. Total interest charge to date of completion on a sum gradually increasing from zero at the start to $14,000,000 at the end of the time would correspond to interest on, say, $7,000,000 for the full time, or at 7 per cent, 730 days at $1,342. The income from sale of current to the same date would be zero.

Let us say that it is possible to speed up the work at the latter end, so as to save ten days of time. The interest charges will be no smaller, but the net profit from sale of current will be $27,000, or $2,700 per day. On the other hand, assume that the work is speeded up so as to save 60 days' time. This can hardly be done without making heavy payments for labor and materials earlier than they would otherwise be made and the account would now stand: Interest during construction, 670 days at $1,342 per day; interest after completion, 60 days at $2,684 per day; net profit from sale of current, $2,700 per day for 60 days. The money received from sale of current amounts to $162,000; but the increase in interest charges amounts to $80,520 (60 days at $1,342) and the net gain which could be available as "bonus and penalty" is $1,358 per day.

MORTIMER F. SAYRE,
Assistant Professor of Applied Mechanics,
Union College.

Schenectady, N. Y., June 11, 1924.

[The editorial was in error in its assumption of $2,684 a day for average interest charge during construction; the figure should be $1,342 as Professor Sayre indicates. However, the net profit of $2,700 per day is exclusive of the interest charges (though the editorial does not make that clear), so that the latter part of his contention is not quite correct. The principle of rapid construction as a money saver holds.—EDITOR.]

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

California Suffers From Severe Water Shortage

City of San Francisco Has Bare Supply To Last to November Rains—Drought Is Unequalled

Several years of subnormal rainfall in California culminating with practically no rain last winter and only a very light fall of soft snow in the mountains which did not pack and was followed by an early runoff of small volume, have combined to cause a serious water shortage throughout the state.

The minimum flow of the Sacramento river usually occurs in August, yet this year since the latter part of May the river has continuously been lower than at any time during the thirty-year period over which records extend. On account of the low water there has been no navigation on the river above the city of Sacramento for the last two months. In the vicinity of Fresno about 400,000 acres are ordinarily irrigated by water from Kings river; this year no water was available for that purpose. All stored water supplies are below normal. In San Francisco the Spring Valley Water Co., after careful reckoning, estimates that it has just enough water to supply the city until about November first when winter rains normally occur. Salt water has been substituted for the fresh water formerly used in San Francisco's high pressure fire system.

Forest Fire Menace

The extreme dryness of grass and underbrush which now approximates the condition ordinarily obtaining in September has greatly increased the menace of forest fires and lengthened the so-called serious fire season from two to four or five months. Toward the end of June the U. S. Forest Service announced that more than 400 fires, extending over 30,000 acres, had already occurred within and adjacent to the national forests; scores of others had burned over state and private lands and many serious fires were then in progress.

In addition to the water shortage that affects the entire state, in southern California there is also a serious power shortage. Due to the wide territory it serves, the Southern California Edison Co. has been forced to order a curtailment in energy consumption of 25 per cent over its entire system. Much of the work on its hydro-electric projects has been discontinued and in conjunction with this the personnel of the engineering staff has been cut 62 per cent. Previous reference to the power shortage in southern California appeared in *Engineering News-Record*, June 26, p. 1115.

H. G. Butler, who has been appointed power supervisor for southern California by the California Railroad Commission, has directed the seven electric companies in the southern part of the state to discontinue taking on new consumers, except lighting business amounting to less than two kilowatts per installation, or by special permit. He has also ordered the elimination of all sign display lighting in Los Angeles except on Sundays and curtailment of other electrical energy consumption. Both the Los Angeles Railway Corporation and the Pacific Electric Railway have inaugurated the skip-stop system, and are using motor buses as auxiliary means of transportation.

Construction of 230 Miles of Railway Authorized

The Florida, Western & Northern R.R. Co. has been authorized by the Interstate Commerce Commission to construct the following lines of railroad in Florida: From Coleman to West Palm Beach, approximately 205 miles; from Valrico to Welcome Junction, approximately 10 miles; and from Gross to Callahan, approximately 14 miles. The certificate requires that construction shall be commenced by July 1, 1924, and completed on or before Dec. 31, 1925.

The new line is to be a feeder to the Seaboard Air Line, and it was admitted at the Interstate Commerce Commission's hearing that the new railroad is a Seaboard Air Line project.

According to press dispatches, the surveys have been completed, most of the right-of-way obtained, and arrangements have been made for starting the construction at once.

New Georgia Power Tunnel Holed Through

On July 4 the Sawtooth tunnel of the Georgia Railway & Power Co., a short distance north of Tallulah Falls, Ga., was holed through, after a little less than one year's construction work. The tunnel cuts through the ridge lying just downstream of the Mathis dam on the Tallulah River, which dam has heretofore served only for storage and equalization. By means of the new tunnel, the water impounded by the dam can be utilized with a fall of about 150 ft. in a new power development, the Terrora development, adding to the utilization of the Tallulah River water by the chain of power houses of the company.

The Sawtooth tunnel is 5,452 ft. long and 13x15 ft. in section; its roof is a semi-circle of 6½-ft. radius, with springing line 8½ ft. above the floor. It was driven by a full-width heading about 9½ ft. high, kept 40 to 50 ft. ahead of the bench face.

Construction of the tunnel was under the direction of Charles G. Adsit, chief engineer, William M. Hammond, assistant chief engineer, and James E. O'Rourke, resident superintendent.

Counterweight Rope of Bascule Bridge Breaks

No Serious Results Attend Accident to Structure Crossing Coney Island Creek, New York

A small roller counterweight bridge crossing Coney Island Creek on the line of Harway Ave., or West 17th St., Brooklyn, N. Y., was put out of operation July 11 by the breaking of one of the counterweight ropes of the bridge. The counterweight rolled down and fell off the rear end of its curved track. The bridge had just been closed, and the fall of the counterweight had no serious results. Street traffic was only momentarily interrupted but the bridge could not be opened for navigation until a new rope could be placed.

Type Unusual

West 17th St. bridge is one of a very few bridges of this type that have been constructed. The bascule span is about 50 ft. long, is hinged at the heel and is counterbalanced by ropes attached at the forward corners, leading back over sheaves on towers at the heel end of the span to two rolling counterweights, one on each side of the bridge, traveling on concave-curved tracks, extending from the tower top to ground level some distance back of the tower. The track curve is such as to produce a constant counterweight effect, which in the case of this bridge, with a total weight of 45,000 lb. in each of the two counterweights, is slightly less than complete balance, the bridge leaf having in all positions a tendency to close.

The bridge is opened by means of an electric motor which winds a hoisting rope, also passing from the forward end of the span over a sheave on the tower; it closes by gravity, under control of the motor brake.

Each of the two counterweight ropes of the bridge is 1¾ in. in diameter. It is connected to its counterweight by a yoke of steel eyebars which engage the center pin of the counterweight and have the rope socketed into a rear crosshead. The original ropes were replaced after ten or a dozen years' service, and the present ropes have been in use since that replacement, or about 15 years. Regular inspection and oiling were provided for, the last inspection having been made on the day before the break. Coney Island Creek being but little used for navigation, the bridge was opened only four or five times daily, a recent year's record showing about 1,000 openings.

No damage to the structure of the bridge resulted from the accident. Both ropes were renewed and the fallen counterweight placed on the track within two days of the accident, by forces of the Department of Plant and Structures, New York City, working under Edward A. Byrne, chief engineer.

Railroad Man Appointed to Study Alaska R. R.

Disorganization Following Activity of New Manager Results in Independent Investigation

Secretary of the Interior Work has appointed Noel W. Smith, assistant to the general manager of the Pennsylvania R.R., as a special assistant to the Secretary of the Interior to make a detailed study of the Alaska R.R. Mr. Smith, who has been granted a leave of absence by the Pennsylvania R.R., will proceed at once to Alaska. Under this title he will study and report on the engineering, supervision, construction, operation, maintenance, finance, personnel and other activities of the Alaska R.R. in the field. His appointment contemplates the making of a complete survey of the road and such reorganization as may seem necessary for its betterment.

Mr. Smith started with the Pennsylvania R.R. as a clerk in 1887 and in 1893 became a permanent employee as a yard man. He has since served as assistant supervisor, supervisor, assistant engineer, and division superintendent. In 1918 he was promoted to general superintendent. In 1921 he was assigned the special duty of reorganizing some of the branches of the Pennsylvania in a capacity of assistant to the general manager.

Work Issues Statement

In a statement just issued Secretary Work says:

"As a result of several months' search for an expert in railroad organization and management, who could be temporarily relieved from his duties, I have appointed Mr. Smith of the Pennsylvania R.R., to survey the physical condition and organization of the Alaska R.R., its freight and passenger possibilities and to make a comprehensive report with recommendations on its requirements, policy, and necessities. Since the completion of the Alaska R.R. no report has ever been made by an experienced railroad operator. To carry out this obvious necessity was the purpose of this appointment."

The appointment of Mr. Smith undoubtedly comes as the result of a very serious situation in the conduct of affairs of the Alaska R.R. and numerous criticisms of the conduct of Col. C. H. Landis, general manager of the road.

Colonel Landis, who had railroad experience in a number of exceedingly minor railroads and a brief experience in railroad service with the American Expeditionary Forces under the direction of General W. W. Atterbury, was appointed general manager of the Alaska R.R. last summer by Secretary of the Interior Work. It is understood that the secretary made this appointment upon the recommendations of General Atterbury and with the approval and expressed recommendation of a number of the leading railroad officials in the United States. Immediately upon his entry upon the duties of general manager Colonel Landis proceeded to a radical reorganization of the personnel of the railroad, dismissing a number of the old employees and bringing in from the States a number of men who had had no experience in arctic and sub-arctic railroads. This brought on vociferous criticism by a number of the citizens of Alaska and resulted in protest to Congress and to the Secretary of the Interior. The latest development, just reported, is that the superintendent, dispatcher and the resident physician of the Alaska R.R., after being dismissed by Colonel Landis have been reinstated by Secretary of the Interior Work. Reports from Alaska state also that U. S. Secret Service men for the last fortnight have been investigating the management of the railroad at the request of Secretary Work, but this cannot be confirmed.

Sewing Machine Vibration Causes Building Collapse

Vibration due to the operation of a sewing machine caused the collapse of an old two-story brick building at 1018 North Eighth Street, St. Louis, on July 2. Mrs. Mamie Mossora, 39 years old, occupant of the second floor and operator of the machine was rescued by firemen as the stairs leading to her quarters collapsed with the south wall of the building. Occupants of the first floor escaped uninjured.

The theory advanced by building department officials is that the old building was weakened by years of wind and rain, and the incessant operation of the sewing machine by Mrs. Mossora, a dressmaker, created sufficient vibration to loosen the supporting joists, resulting in the collapse of the south wall and part of the east wall.

B. G. Lamme, Electrification Pioneer, Is Dead

Benjamin G. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Co. and one of the pioneers in the field of railway electrification, died at his home in East Liberty, Pa., July 8. Mr. Lamme was born near Springfield, Ohio, Jan. 12, 1864, and graduated from the mechanical engineering department of Ohio State University in 1888. The following year he entered the employ of the Westinghouse Co. His aptitude in design was soon recognized and he was given an opportunity to develop his theories. Among his early designs was that of the 5,000-hp. generators for Niagara Falls, by far the largest ever built up to that time. He was a leader in the development of both alternating and direct current apparatus.

In the field of railway electrification Mr. Lamme took an active interest, designing the single-phase motor and generator equipment for the New York, New Haven & Hartford electrification and for the Philadelphia-Paoli electrification on the Pennsylvania, as well as much of the more recent equipment put out by the Westinghouse Co.

War Director of Sales Is Again Vindicated

Judge Bailey Rules Prosecution's Own Evidence Defeats Charge Morse Is Guilty of Fraud

Washington Correspondence

Ernest C. Morse, vice-president of the Triumph Electric Co. of Cincinnati, and War Department Director of Sales under Secretary of War Baker, has been completely vindicated in the Federal Court at Washington, D. C., in connection with charges made in the so-called war-fraud lumber conspiracy case. Federal Judge Bailey overruled the plea of John J. Parker, Special Assistant to the Attorney-General, to submit the indictment against Mr. Morse to the jury. Without hearing reply from Morse's counsel to the government's argument, Judge Bailey ruled that the prosecution's own evidence was such that no reasonable man could find any justification for the charges against Mr. Morse. The Court held that the evidence clearly shows that in connection with the contract for the sale of the surplus lumber to Philips and Stephens, lumber men who are also on trial, Morse had acted for the best interests of the government throughout.

This is the second time during the past six months that federal courts have held baseless charges made against Morse's conduct while in the office of Director of Sales. Last January in the United States Court in West Virginia Federal Judge Groner denounced as "monstrous" an indictment which the Department of Justice had brought against Morse and officials of the United States Harness Co. in connection with the disposal of the huge quantity of military harness which the government had left after the World War.

Frank J. Hogan, of Washington, chief counsel for Morse at both the harness and lumber trials, has announced his intention formally to present charges to Attorney-General Stone against the officials of the Department of Justice who, he alleges, "have wantonly persecuted, for political reasons, a former government official when they had in their possession evidence of his complete innocence." Mr. Hogan said that the prosecuting attorneys in the lumber case "instead of bringing out all the facts had suppressed documents in government files which, if put in evidence, would have completely exculpated Morse."

Federal-Aid Contracts Many

Of the $75,000,000, which became available for Federal-aid roads on July 1, approximately 30 per cent already is under contract as is provided in a special authorization in the law. This has permitted highway work to go forward with great impetus now that settled weather conditions have prevailed throughout most of the country for several weeks. It is estimated that on July 1, roads were being constructed in the United States at the rate of approximately 25,000 miles annually.

New Los Angeles Sewage Plant to Relieve Situation Soon

Contracts have been let for all divisions of the 18-mile north outfall sewer in Los Angeles (the new 300-m.g.d. trunk line whose construction was described in *Engineering News-Record* May 10, 1924, p. 825) and in the latter part of June a total advance on the several divisions of about 600 ft. per day was being made.

The present estimate is that this sewer will be ready for service about the first of next year and that by then the 7-ft. ocean outfall section of this sewer at Hyperion, now under construction and which is being built 6,000 ft. out into the ocean, will be finished. On the completion of the north outfall (the 44-in. temporary outfall, which is now discharging about 20 m.g.d. of screened sewage into the ocean 600 ft. off shore from Playa del Rey) will be abandoned and this flow will be handled in the new trunk sewer.

The north outfall screening plant, which is to contain Dorrco screens of a total capacity (initial installation) of 240 m.g.d., similar to those of 80 m.g.d. capacity now in service at the south screening plant, is to be ready by the time the new (north) outfall is completed. Foundations for the north plant were being laid alongside the south plant early in June. It is to be equipped, as is the south plant, with compressed-air ejectors to deliver screenings to pits in the sand dunes back of the plant. The south screening plant is now operating satisfactorily, handling 60 m.g.d. average flow.

Chicago Again Boils Its Water After 1.28-In. Downpour

During the week beginning June 23, the Chicago Health Department, which is responsible for chlorinating the water, cautioned consumers by newspaper notice to boil the drinking water. The warning followed a downpour of 1.28 in. of rain on June 22. Within 10 minutes 0.65 in. fell. Pollution entered Lake Michigan later at the Calumet 3.6 miles south of the Sixty-Eighth St. intake crib and a small amount, according to observations of health officials, got into the lake at the Thirty-Ninth St. sewage pumping station. Analyses made June 23 by the Sanitary District of Chicago of lake water at these two points and at intervals on the way toward the crib indicate no unusual pollution, however. Samples of treated water taken by the health authorities showed complete absence of B. Coli, indicating the efficacy of the 0.55-p.p.m. chlorine dosage. Despite all these precautions and favorable analyses the "Boil the Water Sign" was hung up and remained up. Dr. H. N. Bundesen, commissioner of health took no chances of a repetition of last fall's typhoid epidemic (see *Engineering News-Record*, Jan. 17, p. 116) when 16 deaths and 116 cases shattered the theretofore low typhoid rate Chicago had been enjoying. He predicted a repetition then but evidently he does not intend it shall occur in his administration.

Canada Marks Time on Waterway

A proposal to form a semi-official corporation, capitalized at $500,000,000, to help build the St. Lawrence waterway, was turned down on July 15 when the Railway Committee of the Canadian House of Commons advised that a bill embodying such a proposition be withdrawn.

Anti-Dumping Decision Put Off

A thirty-days' extension of time, from July 15 to Aug. 15, has been granted by the Treasury Department to all parties interested in the pending investigation into charges that the anti-dumping law has been violated by importations of portland cement from certain European countries. A hearing in connection with this case, which has been before the Department for more than a year, was held before Assistant Secretary Moss early in June.

While no decision has been reached by the Treasury officials, either as a result of the investigation which has been made abroad by its own agents and by consular officers or as a result of the hearing where both the domestic producers and importing interests were represented, the impression has been gleaned in Washington that the case thus far has not been established as conclusive of proof of dumping.

In addition to the questions of fact which have to be decided, the Treasury Department must reach a decision as to whether the anti-dumping act is applicable where admittedly only part of a domestic industry is affected by conditions complained of. This is the situation in the cement case as it is only the domestic producers along the Atlantic seaboard and in California who have complained of foreign competition. The nature of the domestic industry, with plants scattered throughout the country, is such that the interior producers, being close to raw materials and close to their markets for the finished product, are protected against foreign competition by the natural barrier of freight rates from the seaboard to the markets they serve.

Pennsylvania Governor Appoints Giant Survey Board

The appointment of an advisory board of sixteen members for the Pennsylvania Giant Survey, of which Major-General William Crozier, former chief of ordnance, U. S. Army, is chairman, has been announced by Gov. Pinchot. This board will be asked to pass upon the final report of the giant power survey before it is submitted to the Pennsylvania Legislature.

The newly appointed advisory board includes: Dr. Charles W. Eliot, president emeritus of Harvard University; William Allen White, of Emporia, Kan.; Fred A. Gaby, of the Hydro-Electric Power Commission of Ontario, Can.; John R. Freeman, of Providence, R. I.; Henry L. Stimson, of New York City; Arthur J. Mason, of Chicago; Raymond B. Stevens, of Landaff, N. H.; William Kent, of Kentfield, Calif.; Professor Henry S. Graves, of the Forestry School of Yale University; Martha Brinsley Bruere, of New York City; Harry A. Garfield, of Williams College; William B. Mayo, of Dearborn, Mich.; James R. Garfield, of Cleveland; William Mulholland, of Los Angeles; Joseph N. Teal, of Portland, Ore., and Mrs. Maud Wood Park, of Washington, D. C.

Footbridges Started For Delaware River Bridge

Work has been started in erecting the timbers for the two footbridges for construction of the suspension cables of the Delaware River Bridge. Six cables made of 2¼-in. wire rope are used for the support of each of the footbridges. Cables are laid in saddles at the sides and slightly beneath the saddles in which the main cables will rest. The first of the footbridge cables were erected on June 10, as noted in *Engineering News-Record*, and the last of the cables were hung in place on June 25. The two main towers have been pulled back toward the shore to compensate for the deflection that will be produced by the main cables as they are erected and as the suspended structure is added.

FOOTBRIDGE CABLES STRUNG ON PHILADELPHIA-CAMDEN BRIDGE

Lindenthal Advises Redesign of Portland Bridges

Contract of Hedrick and Kremers Is Terminated by $25,000 Payment—Consultant's Fee $119,000

Special Correspondence

Gustav Lindenthal has been retained by the new board of commissioners of Multnomah County, Oregon, to supervise such redesign as is necessary of the three bridges across the Willamette River at Portland, the original design and letting of contracts upon which led to numerous indictments and the recall of the old board of county commissioners. The original news item concerning the scandal appeared in *Engineering News-Record* April 24, p. 740; subsequent items were printed May 15, p. 873; June 12, p. 1036; June 19, p. 1074; and June 26, p. 1115. In his preliminary report Mr. Lindenthal recommends completion of the Burnside Bridge as designed by Ira G. Hedrick and R. E. Kremers with some modifications, and the letting of the contract for its construction to the Pacific Bridge Co., the low bidder at the opening in April.

ROSS ISLAND REDESIGN ADVISED

Mr. Lindenthal also recommends complete redesign of the Ross Island bridge as a steel span instead of concrete arch structure, the redesign to include lowering the bridge from a proposed 135-ft. overhead channel clearance to 80 ft., and the elimination of car tracks. He advises use of new steel for the Sellwood bridge instead of the steel from the old Burnside structure, and a new design to secure better architectural effects.

The contract which Hedrick and Kremers had with the county has been terminated by the payment of $25,000, a previous sum of $123,000 having been paid them. Mr. Lindenthal has been engaged to complete the bridge-building program, his fee to be $119,000. The cost of all three bridges was provided by a $4,500,000 bond issue voted early this year.

The indictments against the old board of county commissioners and against Mr. Kremers have been declared legal by three judges sitting *en banc*. Dow V. Walker, one of the former commissioners, on trial for bribery, has been acquitted on an instructed verdict from Judge Campbell. The trial of Charles Rudeen and Mr. Kremers, also charged with bribery, will begin soon.

Highway Officials To Meet in San Francisco Nov. 17-20

San Francisco has been selected by the executive committee of the American Association of the State Highway Officials for its 1924 convention, which will be held Nov. 17-20. This is the first time the association has met in the far West. The feeling of the committee is that the western members of the association are entitled to a convention at the point most convenient to them since they have for many years been the most faithful in their attendance at conventions despite the long journeys involved.

Hetch Hetchy Water Supply Aids Irrigators During Drought

The San Francisco Board of Supervisors on July 7 approved a plan for releasing to irrigated areas suffering from drought some of the water which the city of San Francisco has stored in Hetch Hetchy reservoir, the consideration to be $1.50 per acre-foot. The areas to be supplied are the Modesto and Turlock irrigation districts which use water from the same stream, diverted at a point lower down. The amount of water sold is about 100,000 acre-ft., or about half the supply at present stored in Hetch Hetchy reservoir. The city has reserved water to insure operation of the Moccasin Creek hydro-electric plant, a part of the Hetch Hetchy project.

Bridge Over Schuylkill at Norristown Burns

Fire on the evening of July 11 destroyed the Ford Street Bridge over the Schuylkill River between Norristown and Bridgeport, Pa. This is the second bridge at Norristown to be destroyed by fire within a period of three months, the DeKalb Street bridge, only six blocks north of the Ford Street structure having been burned on April 14. It leaves Bridgeport and Norristown without means of vehicular communication.

The Ford Street bridge was a combination structure, consisting of a timber truss bridge on the north side, used for vehicles and pedestrian traffic, and a narrower plate girder bridge on the south side carrying a single-track line of the Reading Ry. The timber structure was covered with metal sheathing on the roof and on the side adjacent to the railroad track. It consisted of four spans supported on masonry piers, while the railroad bridge has eight spans, with additional intermediate piers between those that supported the timber bridge.

The fire started at about the center of the bridge. Its origin is unknown, and there are conflicting accounts of its first location. One observer states that it first appeared at the roof of the bridge, whereas another says it appeared as a blue flame at the floor.

The timber portion of the bridge was completely destroyed. The steelwork was damaged by the heat and the plate girders were twisted slightly at some points. Engineers of the Reading Ry. are now investigating the damage to determine what salvage can be secured, and what repairs will be required. At the same time they are constructing timber footways for convenience of pedestrian traffic. If the present steel girders are found adequate, the bridge will be used for vehicular traffic until another crossing can be provided.

The contract for the new bridge at DeKalb Street, to replace the one destroyed in April, was signed on April 11. This contract requires that a temporary bridge be provided within sixty days. Work will be started at once on the temporary bridge. The Whiting-Turner Construction Co. of Baltimore, Md., is contractor for this new bridge.

Random Lines

Some More Varieties

Research Engineers on Technical Publications.—S. C. Dickerhoff, Jr., Inc., of Philadelphia. A careful reading of accompanying literature does not reveal exactly what this firm does any more than does its euphonious subtitle.

Time Engineer—John Timken, who does watch, clock and chronometer work in Dallas, Texas.

Nutrition Engineer—C. Melvin Miller, of Oakland, Calif., who besides being this is also a "food specialist" and who has been telling Michigan poultrymen how graded eggs, uniform in size, color and of high quality will benefit them. Wonder if he knows what the fineness modulus of a dozen eggs is?

Vacuum Engineer—J. A. Butler, of Scranton, Pa., who sells cleaners of the vacuum variety.

Optician Engineer—Reported by a correspondent from Jamaica, W. I., who says he has the name of "Isaac Israel Benrubi, 12 Rue Venizelos, Salonique" in his glasses case.

Investment Engineers—A firm of New York brokers whom we refuse to advertise by name.

Transportation Engineer—Found on the card of a Ford agent.

Color Engineers—Employed by the Fisher Body Co., according to their ads.

Casualty Engineers—The army doctors who developed Zonite, a new antiseptic.

* * *

What the Public Wants

There are times when we despair of the editors of newspapers and other times when we despair of the readers of newspapers whom the editors, in their experience and knowledge, strive to please. Some weeks ago we published a serious note to the effect that a Swedish engineer had produced a light-weight concrete building block by introducing finely powdered zinc or aluminum which in contact with the lime hydrate of the cement liberated hydrogen that made the concrete porous. This interesting, though by no means world-wracking item, would have had decent circulation among those to whom it is of value and gone no further had not a press agency gotten hold of it and dressed it up for popular consumption under the heading "Baking Powder for Concrete." Our desk now groans under the burden of clippings bearing this head. From Dallas to both Portlands it has caught the editor's eye and only insufficiency of time elapsed has kept away the clippings that will yet arrive from Calcutta and Harbin and Melbourne. Our only worry is that a year or so hence we will pick up *Engineering News-Record* and read the sentence that heads each of these clippings—"Raised biscuits of concrete, as light as those mother used to make and much more durable, are now a possibility." When we do our only excuse will be that we know what the public wants.

Calendar

Annual Meetings

AMERICAN SOCIETY OF SANITARY ENGINEERING, New York; Annual Convention, Philadelphia, Pa., Sept. 9-12, 1924.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Rochester, N. Y.; Sept. 30 to Oct. 3.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburgh, Fla.; Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Detroit, Oct. 23-25, 1924.

The San Francisco Section of the American Society of Civil Engineers held its regular bi-monthly meeting June 24. Following reports of committees and a report on the annual convention held at Pasadena June 18-21, W. H. Kirkbride, engineer of maintenance-of-way and structures, Southern Pacific Co., discussed construction coming within his field. On June 28 sixty-six members of the section, under the guidance of N. A. Eckart, chief assistant engineer, Hetch Hetchy project, inspected the construction work on the Bay Crossing Division of the Hetch Hetchy aqueduct.

Personal Notes

THEODORE HORTON, chief sanitary engineer of the New York State Engineering Department, has been appointed sanitary engineer of the city of Albany, N. Y., to serve as special advisor in all matters affecting the hygienic quality of the city's water supply, including the operation and improvement of the existing works and possible new sources of supply. The appointment does not conflict in any way with the service of Allen Hazen as consulting engineer for the construction work now in progress at the pumping and filtration plant, nor with Mr. Horton's work in the state department.

C. E. GRUNSKY, president of the American Society of Civil Engineers, was elected president of the Pacific division of the American Association for the Advancement of Science at the annual convention of this organization held recently at Stanford University, California.

WILLIAM C. BELL has been appointed chief engineer and general manager of the light and power system of the Virginia Railway & Power Co. J. M. PENICK has been appointed general manager of the Richmond & Petersburg Railway Division, and JOHN Y. BAYLISS has been appointed valuation engineer and director of purchases and supplies.

C. H. SCHWARTZ, who until recently was assistant engineer in the Miami Conservancy District, at Dayton, Ohio, has joined the organization of the Southwestern Portland Cement Co. and is working as field engineer at Osborn, Ohio.

ALBERT GIVAN, city engineer of Sacramento, Calif., has been appointed general manager of the Sacramento Utility District. One of the important duties of the position will be a comprehensive survey of the Silver Creek watershed and a report on the Silver Creek hydro-electric project for the city of Sacramento, the report to include also the possibilities of securing a city water supply from the project.

E. D. HAYWARD and W. E. STICH, engineers, Sacramento, Calif., who have been working on the Silver Creek hydro-electric project for the city, have been engaged as part of the engineering personnel of the Sacramento Utilities District.

E. F. KLEMENT, formerly with Auler & Jensen, engineers and architects, Oshkosh, Wis., has been appointed city engineer of Fort Atkinson, Wis.

MARTIN JOHNSON, Rhinelander, Wis., has been appointed city engineer and superintendent of water-works for Rhinelander.

E. S. PENNEBAKER, formerly corporate engineer of the Texas & Pacific Railway Co., has been appointed principal assistant engineer, with headquarters in Dallas, the office of corporate engineer having been abolished.

CHARLES N. GOULD, Oklahoma City, Oklahoma, has been appointed director of the Oklahoma Geological Survey, with office at Norman, Okla. Dr. Gould organized the Oklahoma Geological Survey in 1908 and formulated its earlier policies, but resigned in 1911 to enter consulting engineering. He has been influential in developing the oil, gas, and coal resources of the state.

E. W. NEELANDS having severed his connection with the engineering firm of Sutcliffe & Neelands, New Liskeard, Ont., the name has been changed to the Sutcliffe Co., Ltd. H. W. Sutcliffe is president and T. S. Armstrong, who has been associated with him for the past nine years, is vice-president.

FRED R. LOW, editor of *Power*, has been elected to honorary membership in the Institute of Mechanical Engineers, of London.

ALLEN J. SAVILLE, who has been Director of Public Works of the city of Richmond, Va., for some years, has resigned, to take effect Aug. 10. Mr. Saville is going into business in Richmond in engineering and contracting and is to have a number of the men of the present department of public works associated with him. He is to make a specialty of municipal work, taking care of both plans and designs of municipal enterprises and giving advice as to the operation of various municipal departments, such as street cleaning.

MALCOLM M. INGLIS, for nine years manager of the public utilities of Port Arthur, Ontario, has resigned to become assistant to the vice-president of the Brazilian Traction, Light & Power Co. at Rio Janeiro.

Prof. H. M. MACKAY, professor of civil engineering in McGill University, Montreal, has been appointed dean of the faculty of applied science in succession to Dr. F. D. Adams, who has retired. Professor Mackay received his early education at Pictou Academy in Nova Scotia and at Dalhousie University. He is also a graduate of McGill University, the staff of which he joined in 1904, later being appointed head of the department of civil engineering. In 1922 he was elected to the William Scott chair in civil engineering.

Obituary

ARTHUR B. NIELSEN, general superintendent of the Great Western Portland Cement Co., Kansas City, Mo., was drowned June 28 in an attempt to save the life of his assistant; he was 32 years old. Mr. Nielsen was a native of Norway and received degrees in civil and mechanical engineering in the technical schools in that country. Previous to going to the Great Western Portland Cement Co., he was superintendent of the Mildred plant for F. L. Smidth & Co., engineers, New York City, and prior to that had worked for this company on design and construction of the Mildred plant.

JACOB FROMHERZ, well-known contractor and builder of New Orleans, La., died recently at the age of 77 years.

OSKAR HUBER, Portland, Ore., for twenty years a prominent contractor for paving and highway construction, died June 25 at his home in that city. Mr. Huber was born in Switzerland and came to this country as a boy. For a long time he was connected with the Warren Construction Co.

JAMES Y. MCCLINTOCK, Rochester, N. Y., for seventeen years superintendent of highways for Monroe County, New York, and later associated with George R. Newell in a general engineering firm, died recently at his home in Rochester, at the age of 71 years. Mr. McClintock was at one time city engineer of Rochester, and prior to that had designed and built gas works in that and other eastern cities; in his early years he did railroad survey work in the West and in Maine and bridge, dam and tunnel work in the East.

DAVID GORTON THOMAS, consulting engineer, Denver, Colo., and formerly chief engineer of the Denver Union Water Co., until the property was sold to the city, died June 30 at the age of 65. Born in England he came to the United States when 22 and shortly thereafter became associated with the Denver Water Co., one of the two competitive companies serving the young city. When this company and its rival were combined he was retained as superintendent and for twelve years before purchase by the city in 1918 was chief engineer.

ARTHUR B. CORTHELL, chief engineer of the Boston & Maine Railroad Co., who died on May 24, was born July 3, 1860, at Whitman, Mass., and graduated from Brown University in 1881. He began his active practice of engineering as an assistant engineer on the New York, West Shore & Buffalo R.R. and continued in the railway or allied services for the remainder of his life. He became chief engineer of the Boston & Maine R.R. in July, 1911.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Construction Equipment—Past and Present

A Series of Historical Sketches of the Origin and Development of Machines for Contractors and Engineers

VI—The Road Grader

(*Concluded from last week*)

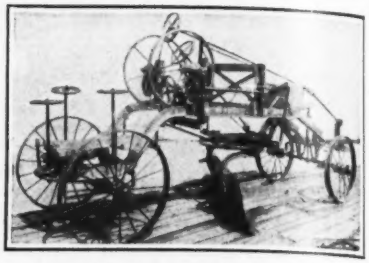
ON the pioneer road graders of the early eighties the blade length, as previously noted in Part I of this article, was limited to 7 or 8 ft. One of the first important developments during the early years of the twentieth century was the equipment of road graders with longer blades. Several causes contributed to this change of design. In the first place, the framework on the original graders was of wood, unable to stand the strains resulting from the use of a larger blade. With the introduction of the all-steel framework, however, it was possible to develop a machine which could take a wider cut than formerly. Then, too, the change from the narrow road of the old days to greater widths opened up a field for a grader with a longer blade. The greatest factor was the introduction of tractor haulage instead of horses, thus placing at the disposal of the road builder increased power for operating his machines, with the natural result of a lengthened cutting blade.

Blades 12-Ft. Long—It was in 1905 that the Adams company introduced a 12-ft. blade machine called the reclamation ditcher, and a couple of years later brought out this same model with a 10-ft. blade. This outfit was merely a large ditch plowing machine with mold adjustable to work at different widths, depths or angles, operating either right-hand or left-hand. It was designed for all kinds and sizes of ditches, varying from small laterals to large canals 3 ft. deep below the original surface and 12 ft. wide at the bottom, with side slopes as steep as 2 to 1. The machine was used also for the construction of levees, and for general land grading and leveling work. It was designed for operation with ten or more horses, two drivers and one operator. The reclamation ditcher was a large machine, 15 ft. between front and rear axles, 52-in. wheel tread, and weighed 3,800 lb. Although the idea of the 12-ft. blade grader had been regarded with skepticism by the field when first proposed, in the course of a year or two competitive 12-ft. blade machines were on the market.

Small Maintenance Graders—As regards length of blade, however, the trend of design went in two opposite directions. In addition to the larger machines, there developed a demand for a small, light grader adapted to highway maintenance under the patrol system. As a result, manufacturers produced graders much lighter than had been used before, ranging in weight from 600 lb. upward, with blades as small as 5 ft. The extremes in design are represented by this light machine and the modern heavy grader with a 12-ft. blade and a weight of 10,000 lb.

Buckeye Grader with Reversible Blade (1900-10)

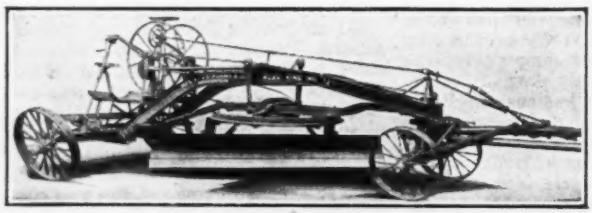
Tractor haulage was responsible for more than an increase in the weight and size of road graders. With the additional power made available by this means of operation, it was possible to add to the grader attachments not hitherto employed. With tractor operation it is desirable, of course, that the hauling unit travel along the center of the road, although frequently the grader must move along the road's side, particularly where a ditch is excavated. The year 1908 saw the introduction of the offset tongue, developed by the Adams organization but, in its early form, not steerable or adjustable while the grader was in motion. The device, however, could be set at an angle which permitted the tractor to travel on the road while the grader worked down in the ditch. Four years later an improvement was made in the form of the steerable engine tongue, the angle of which is adjustable from the grader operator's platform by a steering wheel while the grader moves forward; thus the grader operator may guide his machine independently of the tractor. This marked an important improvement, for with the old rigidly set tongue any variation in the travel of the tractor was noted in the grader.



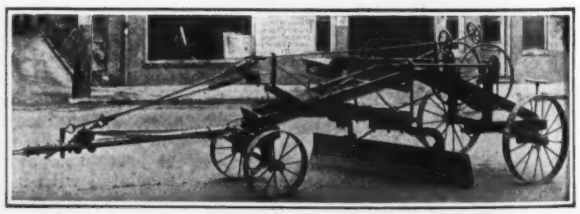
Latest Standard Grader: Blade 8 ft., Weight about 2,900 lb. (Western)

Back Slopers—The next stage in the evolution of the machine was the introduction in 1919, also by the Adams company, of the back-sloper attachment which made possible at one operation the grading of a portion of the road surface and the formation of a flat-bottom ditch at the side. This attachment is essentially an extension of the end of the blade and is carried by a supporting arm connecting to the forward end of the grader draw-bar. The leaning-wheel type of grader is claimed to be particularly adapted to control the heavy cutting action of the back-sloper attachment.

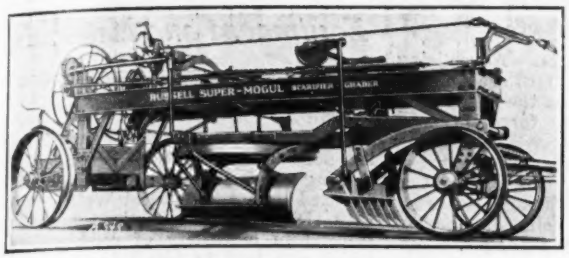
The blade grader machines used during the late nineties and subsequent years were almost entirely what was then termed the "standard" size with a 7-ft. blade weighing from 2,400 to 2,700 lb. About 1908 the Russell Grader Manufacturing Co. offered what is claimed to be one of the first small machines, called the Simplex, a low-frame grader weighing from 1,000 to 1,500 lb. Subsequently other sizes were manufactured, until today the Russell company includes in its line road machines of ten different sizes. Its first 12-ft. heavy road grader, the Mogul, was put on the market in 1913. At that time it weighed 6,000 lb.; this machine has been increased in weight and strength until it now weighs 9,300 lb. without scarifier or backsloper.



Modern Leaning-Wheel Machine with Steerable Engine Tongue (Adams)



Offset Engine Tongue on Modern Grader (Good Roads Machy. Co.)



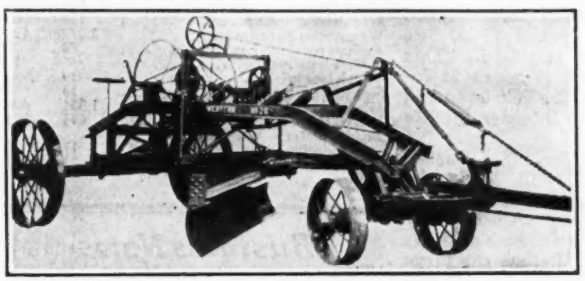
Combined Heavy-Duty Grader and Scarifier with 12-ft. Blade; Weight 9,300 lb. (Russell)

Better Equipment Demanded—Road graders of the blade type up to 1912 or 1913, the Russell company points out, were made as crudely and cheaply as possible, for the use of the machines up to that time had been limited, and the matter of price was a big objection to them on the part of many potential users. Since then, however, the demand of road builders for better equipment has steadily increased and graders built today are of special high-carbon steel to produce great strength. The modern machines are well finished, the parts are highly machined, and close fitting adjustments are offered for the positive control of the blade. Today's improvements are largely in the finish and quality of the machine itself. Manufacturers equip their graders with rubber-tired wheels for maintenance purposes and with roller or ball bearings, tight-fitting bolts and other refinements of construction to reduce operating costs and produce better results. The rubber-tired machines are a product demanded during the last year or two, particularly for use behind trucks at comparatively high speeds. For maintenance purposes the Russell company finds the preference drifting away from the 6-ft. blade and toward the 8- or 10-ft. blade on machines which weigh from 1,000 to 1,200 lb.

Blades on some of the modern road graders, instead of being built in one straight length, are composed of sections so that the several units of the blade may be set to fit more or less closely the contour of the crowned road. This form of construction is exemplified in the Avery Co.'s "road razer," a self-contained unit operating under its own gasoline engine tractor power and the Havelock maintenance grader. Today there are on the market a number of self-powered graders, some of them combined as one machine with Fordson tractors; these include the Wehr, the Hadfield-Penfield, the Gilbert, the Avery, the Huber and others. The Adams company recently announced a tractor-hauled grader with mechanism by which the tractor was controlled from the grader operator's seat. Other recent refinements include extension blades useful both for road maintenance work and—a recent development—snow removal.

When the back-sloper attachment was first introduced it was applied only to the heavier types of road grader; today, however, back-slopers are furnished for all models, ranging from those with the 7-ft. blade up to the 12-ft. machine. Blade wear has been reduced by an innovation in the form of manganese steel cutting edges. For the quick and easy handling of the blade on a grader, equalizing lift springs have been introduced which also prevent the chattering or jumping of the blade on maintenance work.

Grader and Roller—The demand for a light grader for road maintenance work, previously referred to, brought out a couple of years ago a new form of machine in which the functions of grader and three-wheel road roller were combined. This machine, known as the Austin "Pup," is powered by a Fordson tractor engine and weighs from 3 to 5 tons. An adjustable steel blade is incorporated on the front end as part of the machine, so that the whole weight of the roller can be applied to its cutting edge. The tractor in this machine is behind the blade and rolls and compacts the earth after the blade has leveled it. Adjustable blades of several different types may be fitted on the "Pup" and can be raised and lowered by the operator without leaving his seat.



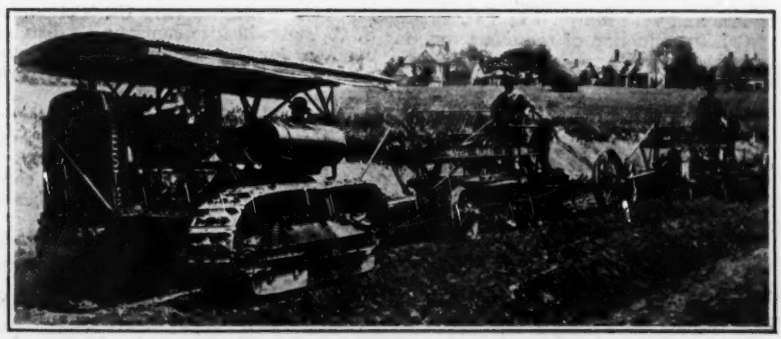
Designed for Tractor Haulage; Note Spring Lift and Extensible Axle (Western)

The Elevating Grader

One of the early offshoots of the grader family was the elevating grader, which combined a plowing blade with an endless belt conveyor for receiving the excavated material and raising it to a point of discharge into wagons or cars moving alongside the machine. Among the early designers of this type of equipment were Frederick C. Austin and William J. Edwards, both of Chicago. On Nov. 27, 1888, Edwards was granted a patent on a "grading and ditching machine" which is now known under the name of the elevating grader; he assigned his patent to Austin. The invention was described as an improvement upon the construction of a grading and ditching machine on which Edwards had received an earlier patent, on April 10, 1883. In the patent description of this machine it is stated that "the elevator is arranged transversely with relation to the length of the machine and extended under the main body frame so as to bring its receiving end in a position to receive the earth from the plow, which delivers the soil onto the endless traveling elevator apron or conveyor belt, thereby permitting the belt to convey the same upwardly to the discharge end of the elevator, and there discharge the same either onto the road or into a wagon, as the case may be. The elevator comprises in its general construction one or more (but preferably a plurality of) frames or sections arranged to constitute a desirably long, jointed roll supporting the frame, which carries a suitable power-driven roll for operating the endless belt and idler rolls for supporting and permitting the free running of the same." In this patent Edwards made 44 claims and the description of his device occupies 18 pages of text.

The elevating grader is now about forty years old. According to the records of the Austin Manufacturing Co., the first machine went under the name of the Wauchope and during the early eighties received a gold medal at an Illinois state fair for the particular type of road it was able to build. One of its features was the production of a road with a high crown and good ditches in wet, prairie land, which it was claimed that other machines of the period could not accomplish.

In 1885 the W. S. Edwards Manu-



With Powerful Tractor on Road Construction Two Graders Can Be Operated in Tandem (Russell)

facturing Co., of Chicago, built this machine or one like it and called it the "New Era." Two years later the Austin company, then just formed, bought out the Edwards company and acquired the elevating grader which has been built ever since. It was this grader which the Northern Pacific R.R. carried free of charge into the Red River Valley of Minnesota and North Dakota during the eighties on account of its service to land development, as previously noted in this article.

Another company which has taken part in the development of the elevating grader is the Russell Grader Manufacturing Co. of Minneapolis. As distinguished from its early machines, the present models are built of higher grade material, largely crucible steel castings, instead of ordinary cast-iron or malleable iron. Shafts are of larger dimensions, of high carbon, cold rolled steel and run in bronze bearings as compared with ordinary cold rolled malleable or cast-iron castings with no bearings other than the cast-iron box originally used. Recent improvements have related largely to the strengthening of the machine for tractor power. One of the later models uses a 42-in. belt conveyor as against a 36-in. belt which was the old standard. This change was made not so much to increase the capacity of the belt as to add to its strength and to increase its life under heavy loads.

The elevating grader, the Russell company points out, still holds the record as the cheapest method of loading earth into wagons wherever the contour of the land is favorable to the use of this machine. Before the large 10- or 12-ft. blade graders came into use, the elevating grader was claimed also to be the cheapest method of delivering earth onto a grade. With the modern 12-ft. blade grader, however, this operation can be accomplished more cheaply than with the elevating grader, provided the difference in elevation between grade and ditch does not exceed 18 in.

Developments Since 1900

In Part I of this article the developments in the road grader up to the beginning of the twentieth century were summarized. Since 1900 the chief improvements have been:

(1) Use of 10-ft. and 12-ft. blades instead of the 7- and 8-ft. blades on the early machines.

(2) Development of light patrol maintenance graders weighing 1,000 lb. or less and with blades 6 to 8 ft. long.

(3) Introduction of the offset tongue and the steerable engine tongue following the operation of graders by tractors instead of horses.

(4) Introduction of the back-sloper attachment for forming ditch at side of road.

(5) Use of alloy steels to increase the strength and reduce weight of frame.

(6) Multiple-section or articulated blades to conform to the crowned contour of the road.

(7) Incorporation of blade grader and tractor as a single self-contained unit.

(8) Increase of blade length by extensible arms for maintenance and snow removal work.

(9) Refinements of design and construction including ball and roller bearings and rubber-tired wheels.

(10) Incorporation of grader blade and roller in one machine for maintenance work.

(Additional articles in this series on "Construction Equipment—Past and Present" will appear in forthcoming issues.)

Milwaukee Industrial Body Elects Officers

Milwaukee Industrial Advertising Association closed its third season with a meeting and dinner at the Republican House, Milwaukee, a fortnight ago. A. H. Obendorfer, Sivyer Steel Casting Co., was unanimously elected president; A. H. Brandt, Chain Belt Co., treasurer; O. C. Dahlman, Koehring Co., secretary; and John J. Keegan, Bucyrus Co., publicity manager.

Simplified Practice Status

The recommendations for simplified practice affecting products in the engineering and construction field, already accepted by the various industrial groups under the auspices of the Division of Simplified Practice of the Department of Commerce, are represented in the following table:

	Reductions in Varieties From	To
Vitrified paving brick	66	11
First revision conference	11	7
Second revision conference	7	6
Third revision conference	6	5
Metal lath	125	24
Woven wire fencing	552	69
Woven wire fence packages	2,072	138
Asphalt (penetrations)	88	9
Hollow building tile	36	19
Rough face brick	39	1
Smooth face brick	36	1
Files and rasps	1,351	496
Forged tools	665	351
Roofing slate:		
Descriptive terms	17	8
Thicknesses	21	10
Sizes	60	30

Business Notes

Keystone Machine & Engineering Co., designers, contractors and builders of municipal filtration plants and equipment, whose plant at Oil City, Pa., was recently destroyed by fire, has purchased the Turner-Fricke Co. plant and equipment at Sharon, Pa. The personnel of the Keystone company remains unchanged.

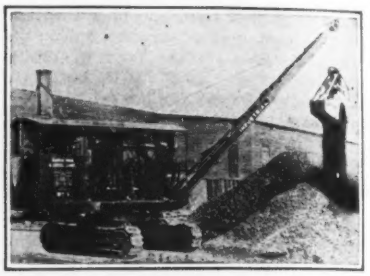
Economy Fuse & Manufacturing Co., Chicago, announces the appointment of Morgan P. Ellis as general sales manager. Mr. Ellis has been assistant general sales manager for the past eight years.

T. Keith Legaré, formerly sales engineer for the Shearman Concrete Pipe Co., Knoxville, Tenn., is now vice-president and manager of the Palmetto Concrete Manufacturing Co., Columbia, S. C., and will also continue as district manager for Dow & Smith, construction, paving and chemical engineers, New York City.

Equipment and Materials

New 10-Ton Crawler Crane

A new 10-ton crawler crane, with independent control of the traveling, slewing and hoisting operations, is announced by the Industrial Works, Bay City, Mich. These motions may be utilized in a variety of combinations which are said to result in increased speed and efficiency of operation. For instance, the hoisting and slewing motions may be combined in bucket work for operation at high speed and when traveling the boom may be swung in any direction to clear obstructions. Slewing in either direction is accomplished, without reversing the engine, by means of a double friction clutch and a train of bevel and spur gears. A slewing brake holds the boom securely with a suspended load in any position. When operating on uneven ground this brake eliminates any possibility of sudden rotation.



The entire upper works rest on a rotating steel base, supported by four conical steel rollers. All gears in the upper works are of cut steel. Lubrication is accomplished by a pressure system, and clutches controlling the various motions are of a friction type which are said to engage smoothly.

The crane has two traveling speeds and reversal of direction is accomplished by reversing the engine. Steering while propelling is accomplished from the operator's platform through friction clutches and brakes controlling each tractor belt. The crane is built for either steam, electric or gasoline power. It is designed to operate with clamshell or dragline bucket, electromagnet, hook and block or grapple, and is convertible into a shovel or a pile driver.

Publications from the Construction Industry

Centrifugal Pumps—Morris Machine Works, Baldwinsville, N. Y., in a newly published bulletin describes its double-suction centrifugal pumps with horizontally split casing. The text covers construction and operating details, and typical performance curves are given showing the efficiencies and other characteristics of different sizes of pumps under various conditions of service. These pumps are designed for handling water, sewage, brine, oil, acids, pulp and chemical fluids.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

June Steel Output Half That of March, 1924

The June output of steel ingots for the entire country was 2,056,466 tons, according to calculations of the American Iron and Steel Institute.

This was slightly under the production total for February, 1922, of 2,071,772 tons. A total of 3,767,256 tons were produced during June of last year, while May, 1923 was the record month of that year with 4,216,355 tons.

The present rate of production at the steel mills is just about half that of March of the current year, at which time the production peak, so far in 1924, was attained.

In the accompanying tabulation, a comparison of the first six months of this year is made with the corresponding period of 1923, both as to monthly production and approximate daily output of openhearth and bessemer steel ingots.

1923	Calculated Monthly Production All Companies Tons	Approximate Daily Production All Companies Tons
January	3,841,095	142,263
February	3,471,843	144,660
March	4,066,680	150,618
April	3,963,736	158,549
May	4,216,355	156,161
June	3,767,256	144,894
6 mos.	23,326,965	149,532
1924		
January	3,633,639	134,579
February	3,809,185	152,367
March	4,187,942	161,075
April	3,333,535	128,213
May	2,628,261	97,343
June	2,056,466	82,259
6 mos.	19,649,028	125,955

Unfilled orders on books of the U. S. Steel Corporation, on the last day of each month, for the first six months of this year and last, are given as follows:

1923	Tons
January 31	6,910,776
February 28	7,283,989
March 31	7,403,332
April 30	7,288,509
May 31	6,981,351
June 30	6,386,261
1924	Tons
January 31	4,798,429
February 29	4,912,901
March 31	4,782,807
April 30	4,208,447
May 31	3,628,089
June 30	3,262,505

Next week — Data on forty-one large contracts, totaling $152,244,304, *awarded during first six months of* 1924.

Public Bond Sales in June

State and municipal bond sales for the month of June were the heaviest for any month on record according to *The Commercial and Financial Chronicle*. The total for the month was $268,133,094 compared with $161,070,397 of June, 1923. December, 1921, held the previous record with an aggregate of $220,466,661.

There were many large issues placed by states and cities. New York City disposed of an issue of $137,500,000. Los Angeles issued bonds for $11,433,000. The state of New Jersey marketed a total of $11,000,000, while North Carolina placed $10,000,000; Illinois, $9,000,000; Mississippi, $5,816,500.

The greater number of the issues found a market at a premium, while a few went at par or below. The interest rate ranged from 4 to 6 per cent.

REPRESENTATIVE PUBLIC BOND SALES, JUNE, 1924

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Illinois	Highways	$9,000,000	4	96.524	4.285	June 1	1935—44	Guaranty Co. of N. Y. and others
Mississippi	.....	5,816,500	5	102.34	.....	.....	.....	Equitable Trust Co. of N. Y. and others
New Jersey	Roads	3,000,000	4½	103.4	4.11	July 1	1939	Mercer Trust Co., Trenton and others
	Bridge	2,000,000	4½	103.9	4.09	July 1	1939	Broad St. Nat. Bk., Trenton and others
	Highway	6,000,000	4½	101.09	4.14	July 1	1954	Lehman Bros., N. Y. C., and others
North Carolina	Highway	10,000,000	4½	100.05	4.49	Jan. 1	1934—63	Wm. R. Compton Co., N. Y., and others
County								
Darke, O.	Roads	7,500	5½	100.46	5.335	June 2	1925—29	Farmers' Nat. Bk., Greenville
Davies, Ind.	Roads	64,170	5	102.35	4.52	June 16	1925—34	Fletcher Savings Bk. & Trust Co., Indianapolis
Franklin, O.	Road and sewer	171,035	5½	103.73	4.48	June 2	1925—34	Stevenson, Perry, Stacy & Co., Chicago
Glades, Fla.	Highway	277,000	6	100.50	5.96	June 2	1939—54	J. C. Mayer & Co., Cincinnati
Greenville, S. C.	Roads	200,000	5	103.51	4.72	July 1	1944	Stevenson, Perry, Stacy & Co., Toledo
Harper, Kan.	Road	50,000	4½	100.32	4.73	July 1	1925—45	Citizens Nat. Bk., Anthony
Holmes, O.	Bridge	36,000	5	100.509	4.89	June 1	1925—34	Provident Savings Bk. & Trust Co.
Isabella, Mich.	Road	41,500	5	100.58	4.97	May 1	1926—34	Prudden & Co., Toledo
Lackawanna, Pa.	Hospital	450,000	4½	101.28	4.16	July 1	1944	Ed. Lowber & Co., Philadelphia
Miami, Ind.	Roads	50,410	4½	100	.....	May 15	Serially	Wabash Valley Trust Co., Peru
Madison, Miss.	Roads	20,000	5½	100	.....	May 1	1925—45	Canton Exchange Bank
Miami, O.	Roads	13,500	5½	100	.....	Feb. 1	1926—30	Industrial Com. of Ohio
Morris, N. J.	Road impvt.	446,000	4½	100.89	4.11	July 1	1925—39	Prendergast & Co., N. Y. C.
Mercer, N. J.	Road and bridge	2,263,000	4½	101.43	4.345	July 1	1926—45	B. J. Van Ingen & Co. of N. Y. C., and others
Middlesex, N. J.	Road impvt.	144,000	4½	100.95	4.38	June 2	1926—43	Clark, Williams & Co., N. Y. C.
	Gen. impvt.	58,000	4½	100.43	4.40	June 2	1926—30	New Brunswick Trust Co.
	Bridge	17,500	4½	100.97	4.38	June 2	1926—43	New Brunswick Trust Co.
New Castle, Del.	Highway impvt.	250,000	4½	100.26	4.22	June 1	1928—44	W. A. Harriman & Co., N. Y. C.
Nassau, N. Y.	Road	1,400,000	4½	101.87	4.02	Sept. 1	1925—46	B. J. Van Ingen & Co., N. Y. C., and others
	County bldgs.	750,000						
Putnam, N. Y.	Highway impvt.	47,000	4½	104.29	4.31	Aug. 1	1925—48	Sherwood & Merrifield, Inc., N. Y. C.
Pike, Ind.	Roads	21,344	5	103.04	4.40	May 15	Serially	Meyer-Kiser Bk., Indianapolis
Redwood, Minn.	Drainage	140,000	4½	100	.....	June 1	1930—44	Minneapolis Loan & Trust Co.
Rock, Wis.	Highway impvt.	200,000	5	104.414	4.50	June 1	1934—35	Taylor, Ewart & Co.
St. Clair, Mich.	Roads	81,500	5½	102.85	5.104	May 1	1926—34	Detroit Trust Co., Detroit
Saginaw, Mich.	Roads	292,950	5½	100.56	5.05	June 1	Serially	Howe, Snow & Bertles, Detroit
Waseca, Minn.	Highway	250,000	4½	101.20	4.39	June 1	1935—44	Minneapolis Trust Co.
Warren, Miss.	Bridge	206,000	5	101.39	4.93	.....	.....	Mississippi Valley Trust Co., St. Louis
Township								
Cross Creek, Pa.	Road	43,000	4½	100.13	4.49	July 1	1929—49	Redmond & Co., Pittsburgh
Jefferson, O.	Road impvt.	7,500	5½	100.56	5.29	May 1	1925—29	Commercial Bk., Celina
Sylvania, O.	Road impvt.	1,225	6	100	.....	June 1	1925—26	Farmers & Merchants Bank, Sylvania
Municipalities								
Chicago South Park Dist., Ill.	Impvt.	3,000,000	4	98.17	4.23	June 1	.....	Illinois Merchants Trust Co. and others
Jersey City, N. J.	Water	1,963,000	4½	105.09	4.355	June 1	1925—62	Trust Co. of New Jersey, Jersey City
	Gen. impvt.	672,000	4½	103.94	4.36	June 1	1925—50	
Los Angeles, Calif.	Public library	1,333,000						
	Harbor impvt.	5,000,000						
	Playground	500,000						
	Viaduct	1,000,000	4½	100.01	.....	Feb. 1	1924—64	First Nat. Bk. and others
	Police protection	1,600,000	4½					
	Incinerator	600,000						
	Fire boats	400,000						
	Bridge	1,000,000						

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 27 to 41, are the following:

Office, Chicago, Ill., Jewelers Assn. to Starrett Bros., $5,000,000.

Steam Turbine Station, Kingston, Pa., Gas and Electric Co. to Stone and Webster, $5,000,000.

Theater and Office, Chicago, Ill., Balaban & Katz to Paschen Bros., $2,000,000.

Theater and Office, Chicago, Ill., Sawyer Amusement Co. to Neslo Wagstad Co., $1,800,000.

Hotel, Duluth, Minn., Duluth Hotel Co. to Jacobson Bros., $1,400,000.

Storage and Garage, Worcester, Mass., Worcester Parking Co. to L. A. Scott & Son, $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 27 to 41, are the following:

Plant, Massillon, O., Central Steel Co., $10,000,000.

Sewers, Richmond, Va., Office Pub. Wks., $1,650,000.

Hotel, Huntington, W. Va., Pritchard Hotel Co., $1,000,000.

Call money, July 14, at 2 per cent.

Time loans for short terms, rated at 2½@3 per cent; longer periods at 3¼@3½ per cent.

Commercial paper rates for best names, 3½@3¾ per cent; other names, 4 per cent.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of July 3, the next, on August 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.44	$3.80	$4.20	—$3.20	$3.45	$4.10	$3.60	$3.60	$4.20
Structural rivets, 100 lb.	4.00	4.35	4.90	3.65	3.90	5.15	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.34	3.30	3.38	3.10	3.35	3.87½	3.65	3.50	2.70
Steel pipe, black, 2½ to 6 in. lap, discount	44%	55%	43%	47%	55.05%	36%	36.80@49.10%	45%	47.43
Cast-iron pipe, 6 in. and over, ton.	60.60@61.60	45.50	59.00	57.20	58.50	68.00	59.00	65.00	65.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	1.90
Gravel, ¾ in., cu.yd.	1.75	2.00	2.38	2.75	1.85	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	3.00	1.75	3.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20.ft. and under, M.ft.	+57.00	36.00	57.20	51.50	38.75	36.75	—34.00	—22.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	16.00	25.50	24.00	22.60	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.65	1.85	1.50	1.40	2.70	2.15	2.80	10.50
Common brick, delivered, 1,000	—21.45@23.65	11.00	14.10	12.00	13.00	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.091	.11	.094	.08	.075	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.091	.11	.094	.....	.075	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	+1.00	+1.07	1.14	.94	1.08	1.18	1.05	1.13	1.01
Common Labor:									
Common labor, union, hour	.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	.30@.50	.82½	.50@.55	.35@.50	.50	.62½	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.37). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 30 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Conditions Affecting the Market

Curtailment of production is the rule in most of the basic industries at the present time. This is true particularly of steel, lumber and cement.

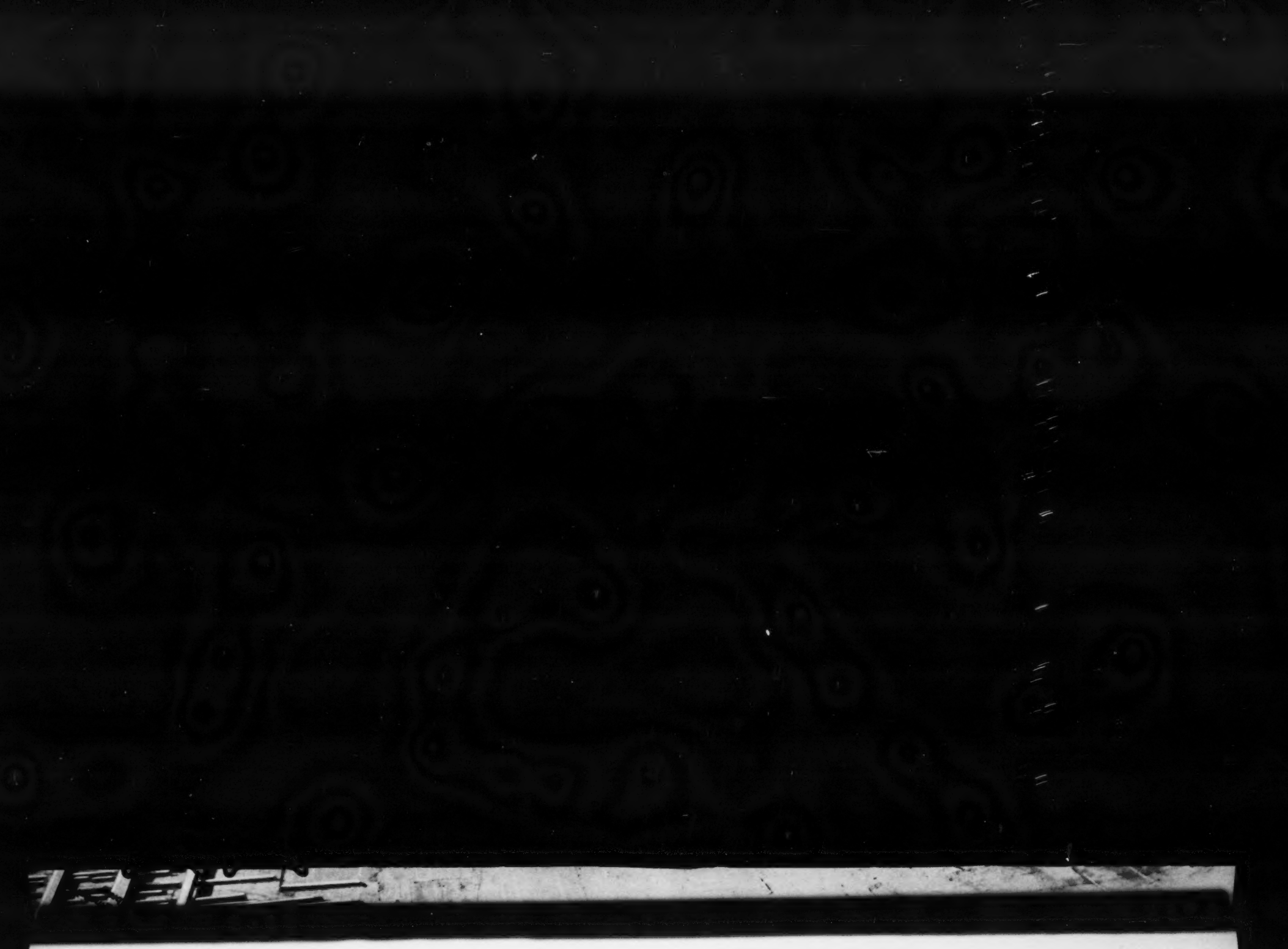
Common brick, however, offers an exception to the general trend in that production, shipments and unfilled orders are on the increase.

While there is no oversupply of brick in the New York market at this stage of the building season, there is evidence of a slight tendency toward price reduction.

Since January, 1923, brick have been $20 per M, wholesale, alongside dock, New York, with the following exceptions: $21 per M in August, 1923; $19 in December, 1923, and $21 from February to March, 1924.

The price situation has shown a predominance of declines over advances during the past thirty days. That this does not threaten to run strongly in favor of the former is indicated by recurrent rises such as that developing in lumber in New York and linseed oil in Atlanta over the week end.

That the construction situation from week to week, according to *Engineering News-Record* statistics, does not follow an unbroken downward trend, is shown by the table of large contracts awarded in the United States, on page 27 of this issue.

The same is true of building permits issued during the past month, as reported by *Engineering News-Record* correspondents from various parts of the country. June permits in the Los Angeles and St. Louis districts fell considerably under the number issued during the same month last year.

The trend is downward in New York for all classes of construction. Tacoma reports an exceptional gain in June, however, over the number of permits issued during the corresponding period in 1923.